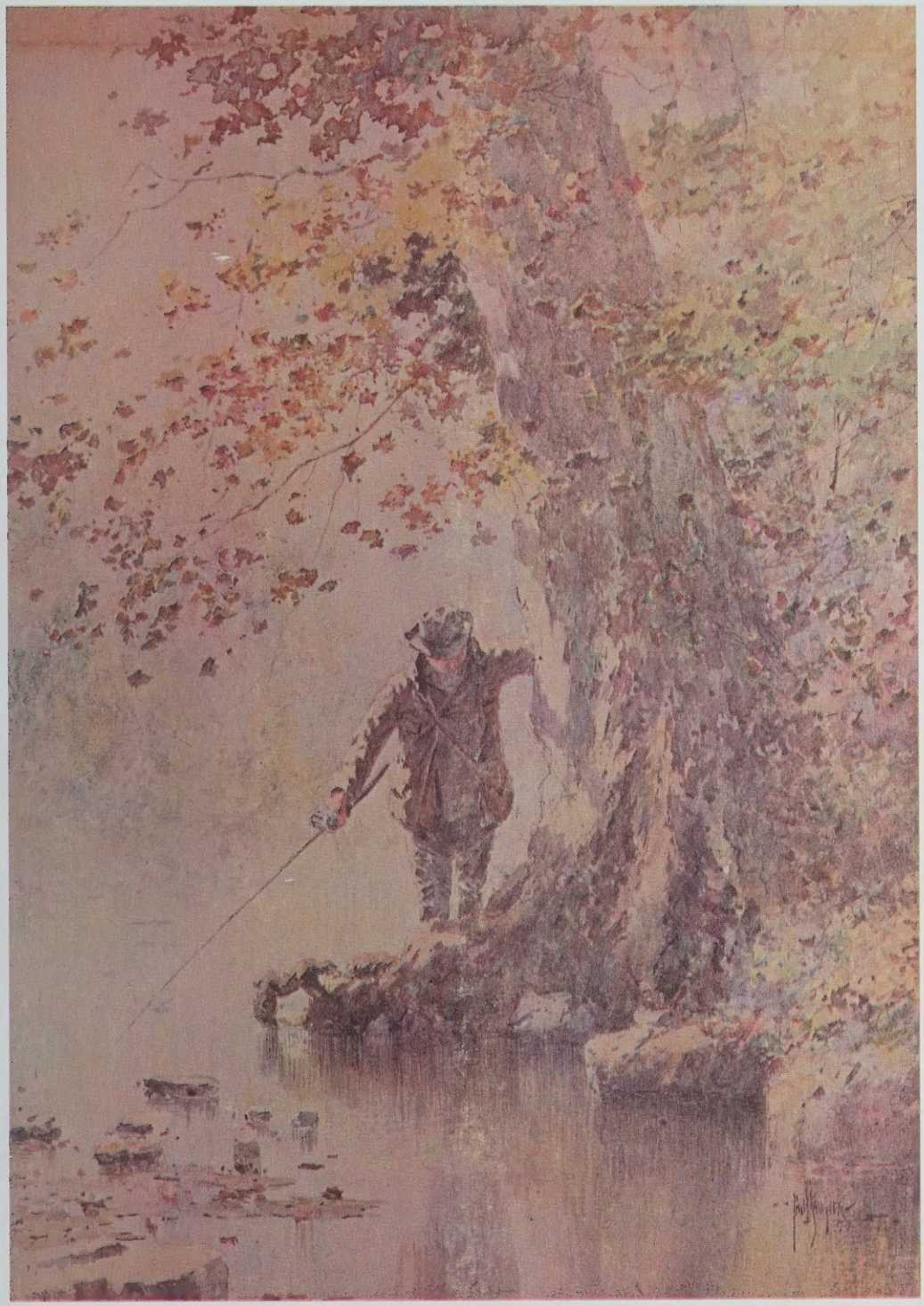
THE RIVER BASIN WATER QUALITY MANAGEMENT PLAN FOR KENTUCKY



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*LCRB means Lower Cumberland River Basin

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1.1m
- 1 — indicates chapter number.
- 1 — indicates exhibit number within chapter.
- m — indicates exhibit is a map; t means table.

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*1-Exhibit identification reads as follows:

1.1m
- 1 — indicates chapter number.
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- m — indicates exhibit is a map; t means table.

*2-LCRB means Lower Cumberland River Basin.

*3-(fp) means "following page number 1-2", etc., since most maps do not have their own page number.

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Chapter I

INTRODUCTION

LOWER CUMBERLAND RIVER BASIN LOCATION WITHIN KENTUCKY

Kentucky is served by ten major river basins, each of which has been investigated for water quality by means of a river basin plan. These plans have been prepared under the guidance of the Kentucky Department For Natural Resources and Environmental Protection (KDNREP) and the United States Environmental Protection Agency. This river basin plan is concerned with The Lower Cumberland River Basin (LCRB) which is illustrated in its geographical relationship to the other drainage basins of Kentucky by Exhibit 1.1m.

The Lower Cumberland River drains 2,084 square miles in western Kentucky. It receives drainage from another 15,830 square miles of the Cumberland River Basin which drains a portion of Tennessee and southeastern Kentucky. The Lower Cumberland River flows northwestward from Tennessee into Kentucky and flows for 75 miles until it joins the Ohio River near Smithland, 59 miles above the junction of the Ohio and Mississippi Rivers. Barkley Dam, near Lake City, impounds 44 miles of this river in Kentucky.

LOWER CUMBERLAND RIVER BASIN LOCATION WITHIN COUNTIES AND AREA DEVELOPMENT DISTRICTS

The Lower Cumberland River Basin drains portions of nine counties in western Kentucky: Livingston, Lyon, Crittenden, Caldwell, Trigg, Christian, and Todd counties in the Pennyrile Area Development District; and Logan and Simpson counties in the Barren River A.D.D. Other river basins which serve the Pennyrile A.D.D., the primary A.D.D. in the Lower Cumberland River Basin, are the Tennessee River Basin, the Ohio River Basin, and the Green River Basin. The geographic relationship of the Lower Cumberland River Basin to the above mentioned counties and A.D.D.s is shown by Exhibit 1.2m.

PAST WATER QUALITY MANAGEMENT PLANNING

Plans and reports have been prepared in the past by various agencies, and for different portions of the basin. This past work is described in the remainder of this section.

County-Wide Plans

Water quality management planning began for sections of the LCRB in the late 1960's. The first significant planning documents were initiated as county-wide water and sewer plans under the auspices of the Farmer's Home Administration (FHA). By the middle of 1972, comprehensive water and sewer plans had been completed for Crittenden, Livingston, Todd, Trigg, Logan and Simpson counties in the LCRB. The primary purposes of these county-wide plans were to give local planning agencies a generalized land use plan as a framework for orderly and effective residential, commercial and industrial development, and a plan showing existing and future needs for water and sewer facilities to serve the developing areas. The sewage facilities development portions of these plans have the greatest impact on the water quality in the areas studied and this information has contributed planning that has been more comprehensive in nature.

Area Development District Plans

In 1973, comprehensive water and sewer plans were finished for the Pennyrile and Barren River Area Development Districts. Water quality goals outlined by these plans were: to provide potable water supplies and adequate sewer services to as many residents and potential residents of the districts as economically feasible; to provide adequate water supply and sewage treatment facilities to meet needs of existing and future industry within the districts; and to maximize economies of scale in existing and proposed water and sewage systems by promoting inter-A.D.D., inter-state, or other feasible combinations of systems, regardless of political boundaries.

The district plans have illustrated, for municipalities, the existing, proposed, and estimated future water and sewer systems required to serve the residents and industries of those municipalities, cost estimates for expanding existing facilities or constructing new facilities have been made. Local, State and Federal Agencies involved with water and sewer utility operating, control, planning and financing have been discussed concerning their roles in such planning.

Kentucky Department For Natural Resources And Environmental Protection Water Resources Plan

The Division of Water, as a division of the renamed Department of Natural Resources, had the Kentucky Framework Water Plan prepared in 1971. This plan had goals to: appraise the needs and desires of the people of Kentucky for the benefits of water resources, assess the supplies of water resources available to meet those needs, describe and integrate the water resource programs of Federal and State agencies, and to recommend specific implementation of plans and programs where appropriate.

Localized Water Quality Plans

Several other plans concerning water resources in the Lower Cumberland River Basin have been completed in the past several years. Portions of these plans have investigated water quality problems in various geographic and political localities throughout the LCRB. The more significant of these plans include: the Corps of Engineers study for the Lake Barkley Impoundment, the North Fork of Little River Watershed study, the Water In Kentucky booklet prepared by the Kentucky Geological Survey and the University of Kentucky, and the numerous Water Resources Investigations In Kentucky prepared by the United States Geological Survey.

Influences On Lower Cumberland River Basin Planning

These water quality management plans have provided much useful data in the preparation of this river basin plan. In particular, the inventory of waste dischargers, the quantities of their effluents, and the locations of affected receiving waters has been most helpful. Other more general data pertaining to growth projections, physiography, topography, geology, soils, surface and groundwater, land use, etc. have been used as complimentary data for this plan.

PROJECT PURPOSE (EPA 131.100)*1

A basin plan is a management document which identifies the water quality problems of a particular basin and sets forth an effective remedial program to alleviate those problems. The basin plan is neither a broad water and related land resources plan nor a basin-wide facilities plan. The value of a basin plan lies in its utility in making water quality management decisions on a basinwide scale. To achieve this objective, the detail of the basin plan should be designed to provide the necessary analysis for basin management decisions.

Moreover, there must be a flexible revision mechanism to reflect changing conditions in the basin. A basin plan should be a dynamic management tool, rather than a rigid, static compilation of data and material.

A basin plan will provide for orderly water quality management by:

(1) Identifying problems. Assessing existing water quality, applicable water quality standards, point sources of pollution, and, if appropriate, non-point sources of pollution.

(2) Assessing needs and priorities. Assessing water quality and abatement needs so as to identify any deficiencies in the Statewide priorities developed in accordance with these Rules and Regulations.

(3) Scheduling actions. Setting forth compliance schedules where permits have been issued or target abatement dates where permits have not been issued and indicating necessary state and local activities.

(4) Coordinating planning. Identifying needs and priorities for section 201 facility plans and section 208 areawide plans within the basin and reflecting the results of those activities.

Public Law 92-500*2

On October 18, 1972, Congress enacted a sweeping revision (PL92-500) of the entire governmental program to control water pollution in this country. The new law sets forth a comprehensive set of requirements for clean-up, which will place heavy burdens on industry and municipalities to treat and reduce the waste they have been discharging into the nation's waterways.

With enactment of the Federal Water Pollution Control Act Amendments of 1972, the United States now has made a long-range commitment to reclaim the purity of our water.

Key Elements of Act

There are several key elements in the action program called for by this new law. They include: 1) stringent new standards for abatement, 2) increased Federal funding for construction of municipal treatment facilities, 3) expanded pollution control planning, 4) tighter regulation through permit requirements for each discharger, 5) full public disclosure of facts about pollution problems and greater public participation in the regulatory process, and 6) streamlined enforcement procedures and stiff penalties to ensure compliance with the new requirements.

1977 Deadline for First Phase

The keystone for the entire program is the new set of effluent standards. Central to these is a July 1, 1977 deadline for completing the first phase of the clean-up. By that date every industrial plant must put into operation the best practicable control technology currently available. Municipalities will also be required to complete construction of facilities providing secondary treatment. These requirements apply across the board to every industrial or municipal discharger. In contrast to the former Federal law, it will no longer be necessary to prove the need for such abatement by evidence (often difficult to collect) of the polluted condition of the rivers or lakes or oceans where the dischargers are located. In certain cases, however, abatement requirements for industries and municipalities will be more demanding where available evidence indicates that more stringent abatement measures are necessary to meet stream quality standards.

The 1972 Act directs the Environmental Protection Agency to issue a variety of other special standards to supplement these basic effluent requirements.

-Special regulations will be issued to control discharges of toxic wastes.

-Pretreatment will be required for industrial pollutants discharged into municipal systems.

-"New Source" regulations will be established to require that the best demonstrated systems of control be utilized in all new plants within the principal industrial categories.

-Special requirements governing oil and hazardous materials, as well as all sewage from vessels, are contained in the new law.

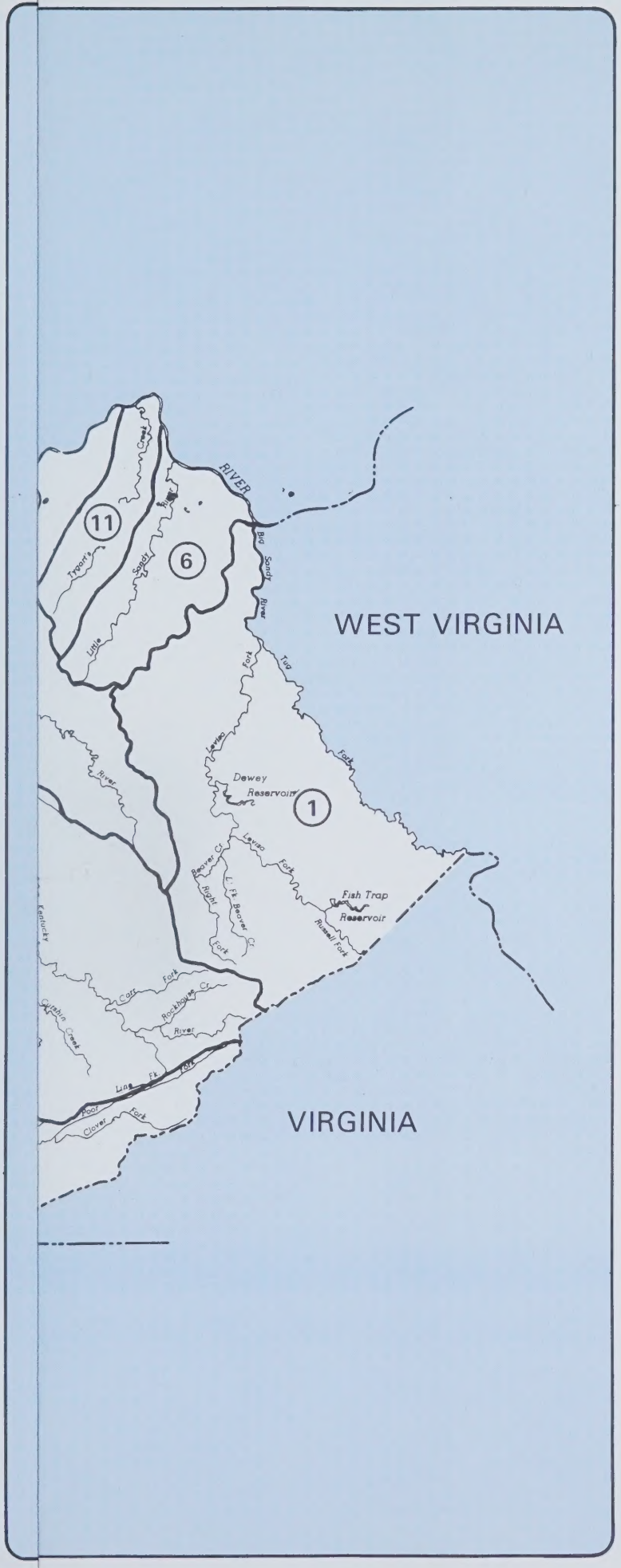
-A Comprehensive program to regulate ocean dumping will be established under the new Act and a related law just enacted by Congress.

No Discharges After 1985

The new Act also looks ahead to a second phase of

*1-Rules and Regulations, Environmental Protection Agency, Federal Register, Volume 39, Number 107, Section 131.100.

*2-"Clean Water-National Commitment Under New Act", by John R. Quarles, Asst., Administrator, EPA, Catylyst, Vol. III, No. 1, 1973.



LOWER CUMBERLAND RIVER BASIN

EXHIBIT 1.1m

BASIN LOCATION

LEGEND

KENTUCKY DRAINAGE BASINS

1	BIG SANDY
2a	LOWER CUMBERLAND
2b	UPPER CUMBERLAND
3	GREEN RIVER
4	KENTUCKY RIVER
5	LICKING
6	LITTLE SANDY
7	MISSISSIPPI
8	OHIO MINOR TRIBUTARIES
9	TENNESSEE
10	TRADEWATER
11	TYGART'S CREEK
12	SALT RIVER

10 0 10 20 30 40

GRAPHIC SCALE IN MILES

Base Data: U. S. Geological Survey

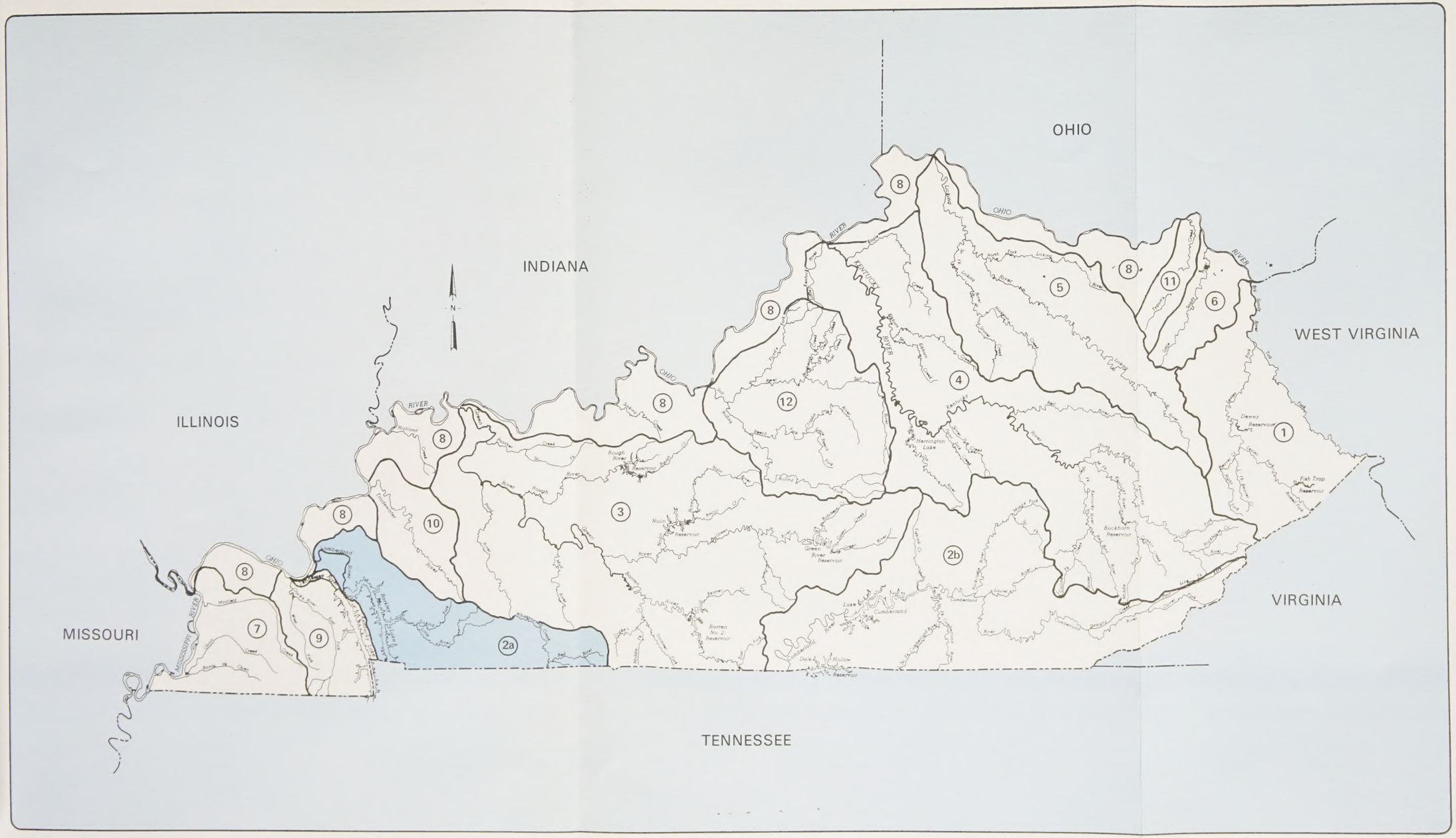
KENTUCKY WATER QUALITY MANAGEMENT PLAN

Prepared for Division of Water Quality

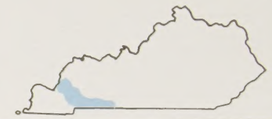
KENTUCKY DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION

G. REYNOLDS WATKINS CONSULTING ENGINEERS, INC.

Lexington, Bowling Green & Louisville, Kentucky



LOWER CUMBERLAND RIVER BASIN



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Lexington, Bowling Green & Louisville, Kentucky

LOWER CUMBERLAND RIVER BASIN

EXHIBIT 1.2m

AREA DEVELOPMENT DISTRICTS

LEGEND

- COUNTY BOUNDARY
- PENNYRILE A.D.D. BOUNDARY
- BARREN RIVER A.D.D. BOUNDARY
- COUNTY SEAT

10 0 10 20 30 40

GRAPHIC SCALE IN MILES

Base Data: U. S. Geological Survey

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LOWER CUMBERLAND RIVER BASIN

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more complete pollution control. By 1983, all industrial dischargers will be required to install best available technology to control their wastes. The law sets as a goal, though not as a regulatory requirement, the complete elimination of discharges by 1985.

New National Permit Program

The new law substantially broadens programs of planning for pollution control. Planning will be carried out on a regional basis. Areawide waste treatment management plans will be developed to identify all necessary pollution control measures to achieve water quality objectives and to develop action programs for their implementation.

The mechanism to implement these more stringent abatement requirements will be a new national permit program to be operated by the states and EPA. Every industry and every municipality must obtain a permit. Other point source dischargers will also be subject to this requirement. The permits will specify abatement programs for each discharger with deadlines for completion of each phase of the program. Effluent limitations will set precise numerical ceilings on all discharges. These limitations will apply not only to the gross pollution load of "BOD", which is a measure of the biochemical oxygen demand of the wastes indicative of their power to deplete dissolved oxygen in the receiving waters. The limitations will also cover other critical characteristics such as total suspended solids, bacteria, alkalinity or acidity, temperature, oil and grease, and individual heavy metals and toxic substances.

Levels of Planning

The levels of planning provided under P.L. 92-500 by section number are:

106-Yearly State Pollution Abatement Work Program

303-Continuing River Basin Plan

402-National Pollutant Discharge Elimination System

201-Local Facilities Plans

208-Area Wide Waste Treatment Management Plans

Grants for Pollution Control Programs

Section 106 of PL92-500 specifies that money will be set aside yearly for grants to states and interstate agencies to administer programs for the prevention, reduction and elimination of pollution. However, grants cannot be made to a state unless it establishes and operates the appropriate devices, methods and systems necessary to compile and analyze data on the quality of the state's water.

A Continuing Planning Process

Section 303(e) requires the state to be involved in continuous planning for maintaining and improving the quality of all its navigable waters. This is being achieved through river basin planning which involves the compilation and analysis of water quality data for each of Kentucky's ten primary rivers. These are: the Big Sandy, Green, Kentucky, Licking, Lower Cumberland, Mississippi, Ohio, Salt, Tennessee, and Upper Cumberland (See Exhibit 1.1m). The completed river basin plans for these major basins will be combined and the result will be a statewide management plan for Kentucky's waterways. River basin planning has been funded with $830,000 from the Kentucky Department for Natural Resources and Environmental Protection (DNREP) and the Governor's contingency fund, and $80,000 from the U.S. Environmental Protection Agency (EPA). The actual process is being performed by various consulting firms with support from DNREP, other state agencies, EPA, and state universities.

Permitting Pollutant Discharge

Section 402 (The National Pollutant Discharge Elimination System or NPDES) regulates the granting of permits to discharge pollutants into public waterways. A permit is issued only when EPA determines that the discharge is complying with requirements outlined in the Water Pollution Control Act. NPDES will be directly tied to the basin planning in the future since permits must be revised on a periodic basis and the stipulations of the permits will be derived in part from the data included in the river basin plans.

Grants For Construction Of Treatment Works

In addition to basinwide planning, other plans are required for urban areas within each basin, as "201" or "208" plans. Most of the urban areas (or cities and towns) in the state fall under the requirements of Section 201. The 201 areas follow the natural drainage system of their river basin.

In order for these designated areas to be funded for designing specific waste treatment facilities, a plan must be submitted in accordance with the guidelines set forth under Section 201. Basically, this plan must indicate that alternative waste management techniques have been studied and evaluated for that particular area.

Section 208 also requires a plan for developing waste treatment facilities. However, 208 is applicable only to those areas which have been designated by the Governor as having substantial water quality control problems. This is generally the case in areas which have high urban-industrial concentrations. In Kentucky, only the Louisville and Northern Kentucky sections have been designated as 208 areas. The requirements under Section 208 call for a more in-depth look at problems than the 201 plans require and more emphasis is placed upon management techniques. The 201 and 208 plans must be compatible with the statewide 303(e) river basin plan. This should not cause any major problems for 201 or 208 plans which are now in progress if their basic conclusions are in agreement with the river basin plans and public participation has been an important part of the process for developing the 201 or 208 plan.

Priority Ranking For Funds

One of the important outcomes of 303(e) River Basin, 201, and 208 planning and data collection is

determining the locations of the most serious water pollution problem areas. These plans will result in a ranking of areas within the state according to need for facility construction grants. The top of the list has priority for available monies. To comply with Section 106 of the Act, the Division of Water, within DNREP will use this priority list to apply for federal funds.

Chapter II

SUMMARY

INTRODUCTION

The Lower Cumberland River Basin, lying in southwestern Kentucky, drains portions of nine counties, borders Tennessee to the south, and discharges surface waters directly into the Ohio River. The basin, subdivided into 22 segments, is shown by Exh. 2.1m.

Past water quality management planning has attempted to prevent obvious stream pollution depicted by discoloration of streams, fish kills, septic odors, and contaminated drinking water supplies.

The purpose of this River Basin Plan is to assist in bringing the streams of the lower Cumberland River Basin up to recently adopted stream water quality standards in accordance with P. L. 92-500. This would insure sufficiently pure water with adequate oxygen levels and absence of toxic waste levels to allow fish and other aquatic life in the streams and safe waters for recreational purposes.

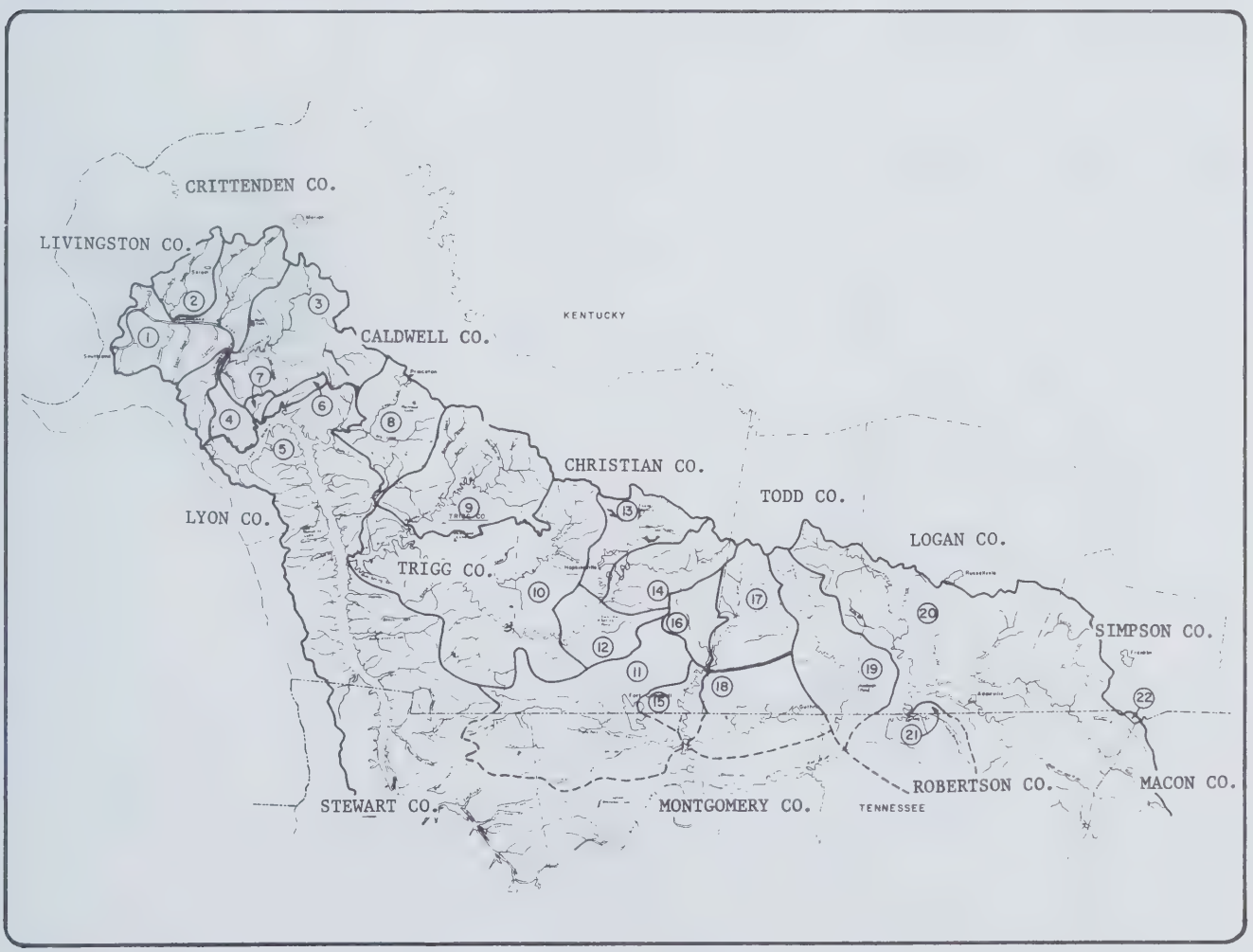
BACKGROUND FOR THE PLAN

Background data for this plan includes the physiography (topography, geology, soils, surface and groundwater), planning data, basin wastewater control methods, existing water quality and applicable standards.

Physiography

The major physiographic impact on water quality in the LCRB is a combination of the predominantly rolling to hilly topography, and the underlying limestone formations which, over countless years, have generated a karst area. This area is pockmarked with sinkholes which are the enty points of surface water to the underground solution channels feeding springs, lakes, and streams. This karst area lends itself to ready pollution of groundwater reserves from non-point and point sources of waste water runoff.

Exhibit 2.1m: Segment Basins in the Lower Cumberland River Basin



Planning Data

Between 1970 and 1995, it is estimated that almost 10 square miles of agricultural land will be transformed into urban-related land use in order to accommodate the needs of over 39,000 additional people in the Lower Cumberland River Basin (LCRB). Over 19,000 new jobs will have to be created to satisfy the employment demand, and over 13,000 housing units will have to be added to the 1970 supply to provide living quarters for the population growth (see Exhibit 2.3t).

The majority of this new urban growth activity is projected to occur in and around the Hopkinsville area, in Christian County. Other growth areas within the LCRB include Princeton (in Caldwell County), the Oak Grove area (in Christian County), and the northern and eastern shoreline of Lake Barkley in Livingston, Lyon, and Trigg Counties, as shown by Exhibit 2.2m.

Not shown in Exhibit 2.2m are potential growth areas in the Counties, but outside the Lower Cumberland River Basin. These would be shown by the plans for the Green River, Ohio River, and Tennessee River Basins.

Relation to State Growth - Another revealing aspect of the LCRB growth is to relate it to projections for the entire State of Kentucky. When this is done, for 1970 and 1995, the following results:

...Surface area - the LCRB's surface area (land and water) of 2,057 square miles represents slightly over 5% of the total Kentucky surface area.

...Population - the 1970 population of the LCRB accounted for 2.9% of the total State population, and is projected to increase to 3.1% of the State total by 1995.

...Population Density - In 1970, the LCRB population density (number of people per square mile of surface area) was 56% of the Statewide average. By 1995, this is projected to increase to 60% of the State average.

...Housing Units - Between 1970 and 1995, the LCRB is projected to add 13,354 housing units, or a 50% increase. During the same time period, population is projected to increase by 43%, density by 42%, employment by over 79%, and urban-related land use by 47%.

...Non-Agricultural Employment - In 1975, the LCRB employment accounted for 2.28% of the State total, and is projected to increase to 2.73% by 1995.

...Land Use - Between 1970 and 1995, the LCRB is projected to add almost 10 square miles, or a 47% increase, for urban-related land use.

Exhibit 2.2m: Major Future Growth Areas in the Lower Cumberland River Basin

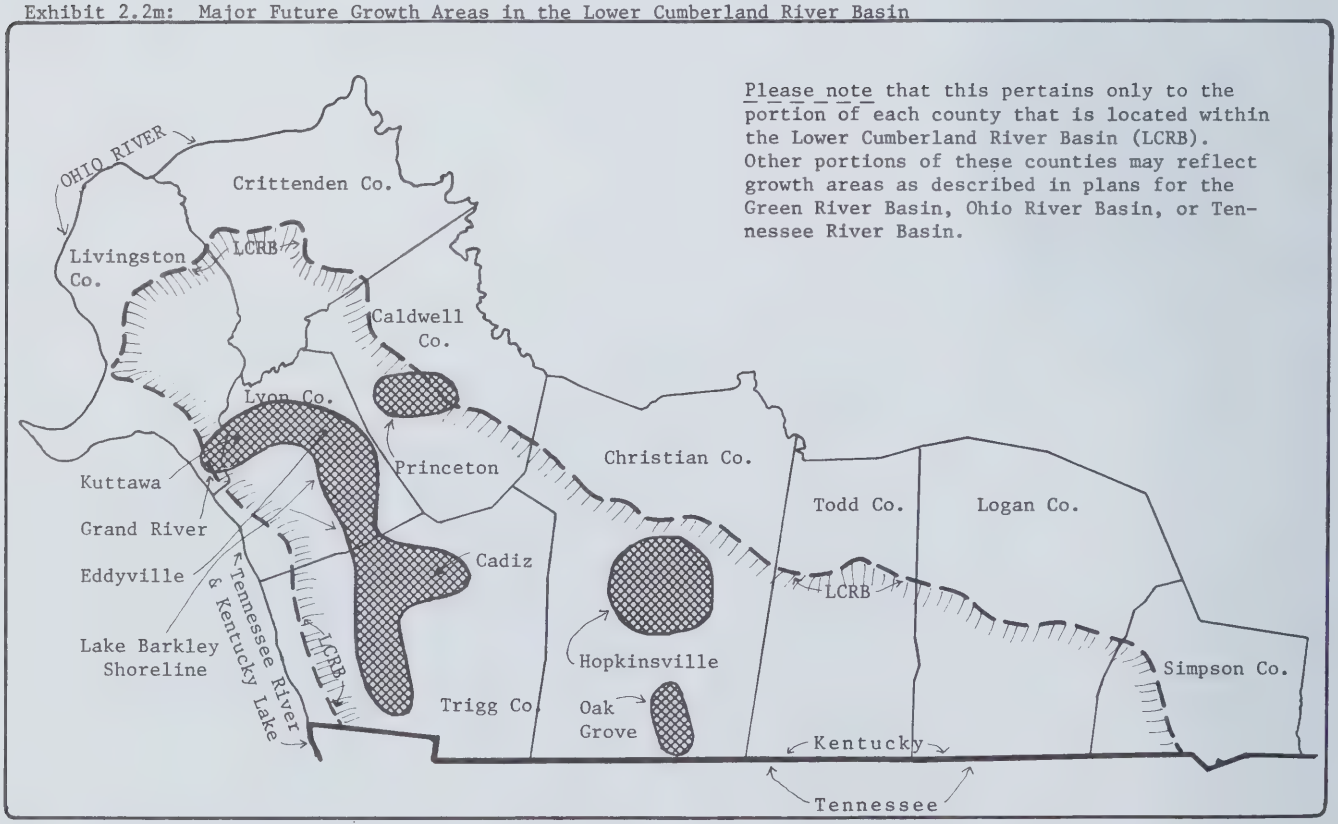


Exhibit 2.3t: Planning Data for the Lower Cumberland River Basin*[1]

Planning Item	"At-Year" Figures				"Between-Year" Changes							
					1970-1975		1975-1980		1980-1995		1970-1995	
	1970	1975	1980	1995	Number	%	Number	%	Number	%	Number	%
SURFACE AREA (sq.mi.)												
..State of Kentucky	40,399	40,399	40,399	40,399	0	0	0	0	0	0	0	0
....Nine Co. Total...	3,710	3,710	3,710	3,710	0	0	0	0	0	0	0	0
......Outside LCRB...	1,653	1,653	1,653	1,653	0	0	0	0	0	0	0	0
......Inside LCRB	2,057	2,057	2,057	2,057	0	0	0	0	0	0	0	0
POPULATION												
..State of Kentucky	2*3,219	2*3,391	2*3,562	2*4,274	171,394	5	171,395	5	712,050	20	2*1,055	33
....Nine Co. Total...	145,344	153,242	161,143	201,781	7,898	5	7,901	5	40,638	25	56,437	39
......Outside LCRB...	53,586	55,347	57,921	70,644	1,761	3	2,574	5	12,723	22	17,058	32
......Inside LCRB	91,758	97,895	103,222	131,137	6,137	7	5,327	5	27,915	27	39,379	43
........Urban.....	41,175	46,175	49,627	67,084	5,000	12	3,452	7	17,457	35	25,909	63
........Rural.....	50,583	51,720	53,595	64,053	1,137	2	1,875	4	10,458	20	13,470	27
.........Farm.....	18,551	19,117	19,820	23,652	566	3	703	4	3,832	19	5,101	28
.........Non-Farm...	32,032	32,603	33,775	40,401	571	2	1,172	4	6,626	20	8,369	26
POPULATION DENSITY*[3]												
..State of Kentucky	80	84	88	106	4	5	4	5	18	21	26	32
....Nine Co. Total...	39	41	43	54	2	5	2	5	11	26	15	39
......Outside LCRB...	32	34	35	43	2	6	1	3	8	23	11	34
......Inside LCRB	45	48	50	64	3	7	2	42	14	28	19	42
HOUSING UNITS												
..Nine Co. Total	44,156	47,720	51,772	64,404	3,564	8	4,052	9	12,632	24	20,248	46
....Outside LCRB.....	17,289	18,343	19,798	24,183	1,054	6	1,455	8	4,385	22	6,894	40
....Inside LCRB	26,867	29,377	31,974	40,221	2,510	9	2,597	9	8,247	26	13,354	50
......Urban.....	11,379	13,079	14,497	19,287	1,700	15	1,418	11	4,790	33	7,908	70
......Rural.....	15,488	16,297	17,477	20,934	809	5	1,180	7	3,457	20	5,446	35
........Farm.....	5,776	6,125	6,565	7,850	349	6	440	7	1,285	20	2,074	36
........Non-Farm.....	9,712	10,172	10,912	13,084	460	5	740	7	2,172	20	3,372	35
NON-AG EMPLOYMENT											4*	
..State of Kentucky	885,801	2*1,099	2*1,313	2*1,647	213,599	24	213,600	19	334,000	25	548,000	50
....Nine Co. Total...	33,434	42,821	55,358	73,216	9,387	28	12,537	29	17,858	32	30,395	71
......Outside LCRB...	-	17,698	22,174	28,343	-	-	4,476	25	6,169	28	10,645	60
......Inside LCRB	-	25,128	33,184	44,873	-	-	8,061	32	11,689	35	19,745	79
........Manufacturing	-	9,151	12,832	17,329	-	-	3,681	40	4,497	35	8,178	89
........Non-Mfg.....	-	15,972	20,352	27,544	-	-	4,380	27	7,192	35	11,572	73
LAND USE												
..Nine Co. Total	3,710.00	3,710.00	3,710.00	3,710.00	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
....Outside LCRB.....	1,653.00	1,653.00	1,653.00	1,653.00	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
....Inside LCRB	2,057.00	2,057.00	2,057.00	2,057.00	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
......Rural	2,036.44	2,034.87	2,033.57	2,026.80	-1.57	-.1	-1.30	-.1	-6.77	-.3	-9.64	-.5
........Agriculture..	1,856.56	1,854.99	1,853.69	1,846.92	-1.57	-.1	-1.30	-.1	-6.77	-.4	-9.64	-.5
........Silviculture.	178.00	178.00	178.00	178.00	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
........Mining.....	1.88	1.88	1.88	1.88	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
........Construction.	-	-	-	-	(1.57)	-	(1.30)	-	(6.77)	-	(9.64)	-
......Urban-Related	20.56	22.13	23.43	30.20	1.57	7.7	1.30	5.9	6.77	28.9	9.64	47.0
.....(Urban-Type Pop)	(73,207)	(78,778)	(83,402)	(107,485)	(5,575)	7.6	(4,624)	5.9	(24,083)	28.9	(34,278)	47.0
.....(Persons/sq.mi.)	(3,560)	(3,560)	(3,560)	(3,560)	0	0.0	0	0.0	0	0.0	0	0.0

1*-This data is extracted from the exhibits of Appendix "A".
2*-Add "000".
3*-Persons per square mile.
4*-All employment changes in this column are for 1975-1995, instead of 1970-1995.

Basin Wastewater Control

The most common means of point source wastewater control in the LCRB is by means of "package type" (factory built) treatment plants which are generally of the extended aeration process type convertible to contact stabilization in the larger of these facilities. These facilities, when operating properly, achieve secondary levels of treatment.

Sparsely settled areas of this basin handle their wastewater most often by means of septic tanks or cesspools which are potential sources of groundwater pollution.

Existing Water Quality and Applicable Standards

Overall water quality in the LCRB is good with significant stream pollution existing only downstream of major dischargers or even smaller discharges on zero Q7-10 low flow streams. Effects of non-point pollution on streams or groundwater quality is not considered significant with the possible exception of Hopkinsville storm water runoff. Groundwater quality overall is good with localized exceptions of well water contamination where septic tanks and leaching field areas are concentrated.

Current water quality standards utilized in determining required treatment levels are Kentucky's W.P.-4-1 and W.P.-6-2 stream standards and P.L.92-500 requirements for secondary and best practicable treatment for municipalities and industries respectively.

WATER QUALITY MANAGEMENT STATUS

The existing status of water quality management in the LCRB shows a total of 82 recorded point source wastewater dischargers.

Segment Classification

The 22 segment sub-basins making up the LCRB have been classified as Water Quality Limited or Effluent limited as defined by P.L. 92-500 with the Water Quality Limited being the segments requiring more stringent treatment levels than currently utilized in order to meet stream standards. Eleven segments are Water Quality Limited and eleven Effluent Limited as determined by the computer model which simulates conditions in the streams. Classifications and segment ranking by priority are shown in Exhibit 2.4t.

Significant Discharges

Municipal, domestic, and industrial discharges were listed as significant if it was found that they had much influence on their receiving stream's water quality. All 11 of the municipal discharges in the basin were found to be significant with 18 domestic discharges, and 4 industrial discharges determined significant. A rule of thumb followed was that a discharge has at least 5000 gpd flow even on a zero Q7-10, low flow stream in order to be significant.

The only non-point source of pollution considered significant in this basin is the Hopkinsville storm water runoff area.

Exhibit 2.4t: Segment Ranking and Priority

Segment Rank	Segment No.	Segment Priority	Segment Classification
1	LC-13	1226.88	WQL
2	LC-19	370.01	WQL
3	LC- 6	333.45	WQL
4	LC- 8	292.77	WQL
5	LC-20	267.77	EL
6	LC- 7	242.64	WQL
7	LC-10	169.50	EL
8	LC-14	140.83	WQL
9	LC- 1	76.94	EL
10	LC-16	20.82	WQL
11	LC-17	13.15	EL
12	LC- 3	12.65	WQL
13	LC- 4	12.24	EL
14	LC- 5	11.08	EL
15	LC- 9	6.20	EL
16	LC-11	3.19	EL
17	LC- 2	2.46	WQL
18	LC-18	1.72	EL
19	LC-12	1.45	EL
20	LC-15	.58	WQL
21	LC-21	.00	EL
22	LC-22	.00	EL

Disposal of Treatment Plant Residuals

The only significant sources of wastewater residuals were found to be the municipal dischargers and the largest of the domestic dischargers. These residuals, consisting of dried sludge are currently disposed of by farm spreading and none is recorded as being placed in licensed landfills.

For the most part water treatment plants discharge their backwash waters into the streams which provide their water supplies.

BASINWIDE MANAGEMENT PLAN

The basic assumptions and data for plan implementation are presented with particular respect for the need of managers to have all the available information necessary for decision making in a compact, concise form.

Basin Plan for 1980 and 1995

The LCRB has been divided into twenty-two smaller drainage basins (segments), for which individual analyses have been made. All the known point source discharges for each segment have been identified and located by river milepoint as closely as possible. Waste load allocations and the allowable 1980 discharge characteristics are presented for each discharge in each segment analysis in Appendix B. These allocations represent the dissolved oxygen and ammonia standards for the receiving stream.

A computer model, developed jointly by the University of Kentucky and University of Louisville, assumed background water quality and used existing discharge characteristics to calculate in-stream conditions. The calculated values included D.O., NH_3N, and $B.O.D._5$ at selected stream milepoints. Exhibits 2.6g through 2.11g show Upstream Drainage Area and Stream Slope,

D.O. and $B.O.D._5$, and Population and Costs at each milepoint modelled. These values were taken from background data, the 1980 computer model, and the estimated municipal treatment needs respectively.

Treatment needs were estimated for municipalities form the projected population growth, projected industrial and urban area growth, and 1975 unit costs for treatment, interceptors, collectors, and infiltration correction. These needs are presented in Appendix B for each segment. Collector needs were projected for 1980, while interceptor needs were projected for 1995 Treatment needs and costs are summarized in Exh. 2.5t.

Exhibit 2.5t: Municipal Ranking and Priorities

Rank	Municipality	Priority	Treatment Level	Treatment Cost ($x10^6$)
1	Hopkinsville	3063.7Aa	T4B	37.3
2	Elkton	917.6Ca	T4B	1.4
3	Princeton	695.3Ca	T4B	3.0
4	Adairville	644.0Ca	T4B	0.289
5	Eddyville	565.2Ca	T4B	1.9
6	Kuttawa	485.3Ca	T1A	0.114
7	Cadiz	287.3Ca	T1B	1.3
8	Smithland	153.9Ca	T1A	0.225
9	Trenton	59.2Ca	T4B	0.060
10	Pembroke	44.7Aa	T4B	0.438
11	Lake City	19.6Ca	T1A	0.174

Compliance goals are set for each minicipal discharge and for each discharge having an NPDES permit. According to PL 92-500, each municipality is required to have at least secondary treatment in operation by July 1, 1977. Industries are required to install the best, practical control technology available by that date. In certain special cases, where evidence indicates that more stringent measures are needed to meet stream quality standards, the abatement requirements will be more demanding. By 1983, all industrial discharges will be required to install the best available technology, and the law sets a 1985 goal of complete elimination of excessive waste discharges. Available NPDES permit numbers and compliance dates are shown in Exhibits 4.3t through 4.7t of Chapter IV for the significant dischargers in the LCRB.

To evaluate the relative need of each segment and each municipality for state and federal aid, a priority system was established. Segment priorities were calculated taking into account the segment population, the existing discharge characteristics of each discharger, and the proposed effluent characteristics for each discharger. Priorities were ranked statewide with ranges of low (0-200), medium (200-1000), and high (greater than 1000). Individual municipal priorities were calculated using the segment priority and the estimated treatment needs for that city. The priority formulas are explained in detail in Chapter IV.

The required treatment standards call for all dischargers to meet the stream standards of Kentucky for aquatic life. These standards call for a minimum in-stream D.O. of 5.0 mg/l, and, in the future, may call for limits on ammonia concentrations. Should the high treatment levels be enforced on small discharges (50,000 gpd or less), financial hardship would result. The streams which have a seven day, ten year low flow of zero cfs accommodate very little aquatic life. Therefore the standards should be reviewed with respect to the discharge size required to upgrade, and stream usage and potential damage which might otherwise result.

Water Quality Monitoring and Surveillance

Existing significant water quality and quantity data was scarce for the LCRB. The data used for the analyses done in this report are tabulated in Appendix A. A list of recommended monitoring stations, their locations, and frequency of parameter sampling are given in Chapter V, Exhibit 5.4t. To implement a management plan of this magnitude a much more complete picture of existing water quality is needed. These proposed stations represent an initial attempt at establishing the monitoring system needed to gather the necessary data.

Relationship of the River Basin Plan to Other Plans

The Lower Cumberland River Basin Plan has been designed to work in conjunction with and guide other plans within the Basin. Planning efforts in the LCRB include 201 Facilities Plans, Soil Conservation Service flood control and retention plans, Corps of Engineers surveillance on Lake Barkley, and several water and sewer plans prepared for the individual counties in the Basin.

Current state records show eleven designated 201 areas within the Basin. The Corps of Engineers, Nashville District controls the usage of Lake Barkley and any related planning effort. Area Development District Water and Sewer Plans have been developed for the Pennyrile A.D.D. and the Barren River A.D.D. These plans give useful information on the present and future needs for specific areas. The Kentucky Framework Water Plan includes the LCRB in an overall view of the state's water quality. These plans should work hand in hand with the River Basin Plan as management tools.

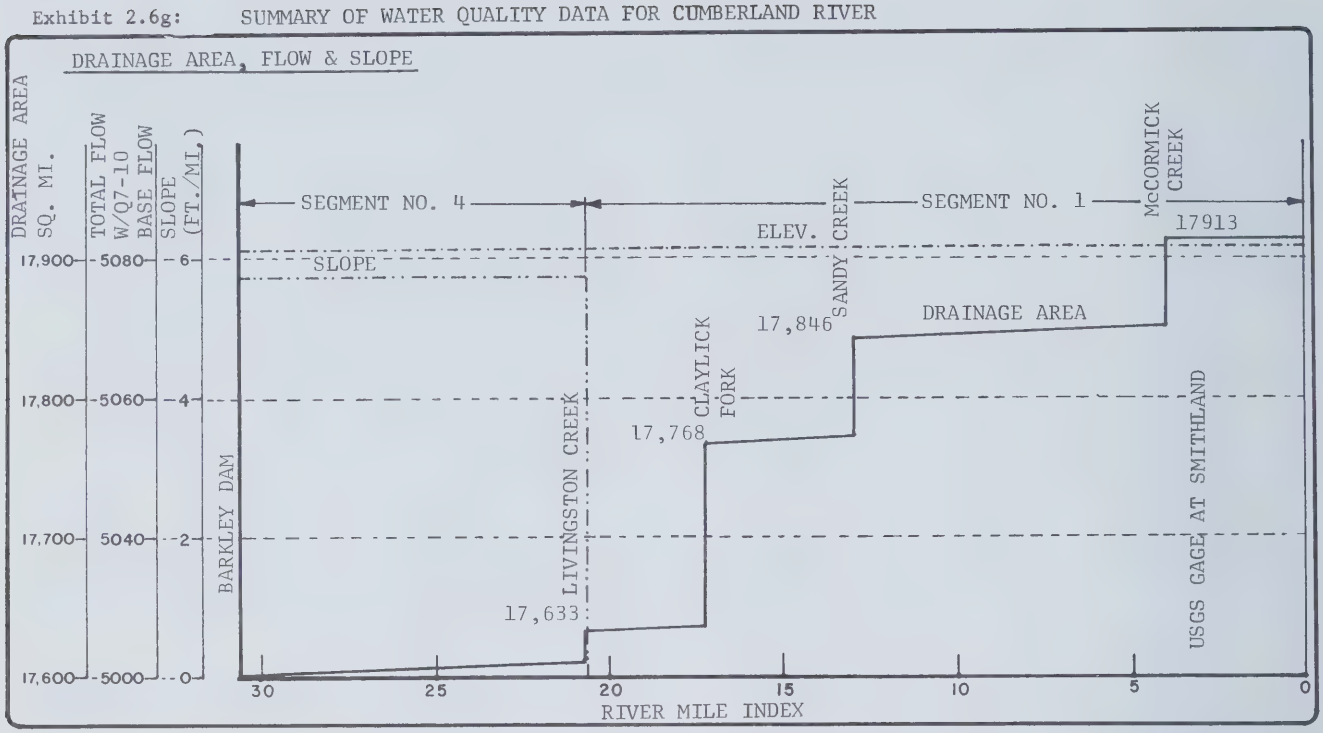
Land Use Policies and Controls

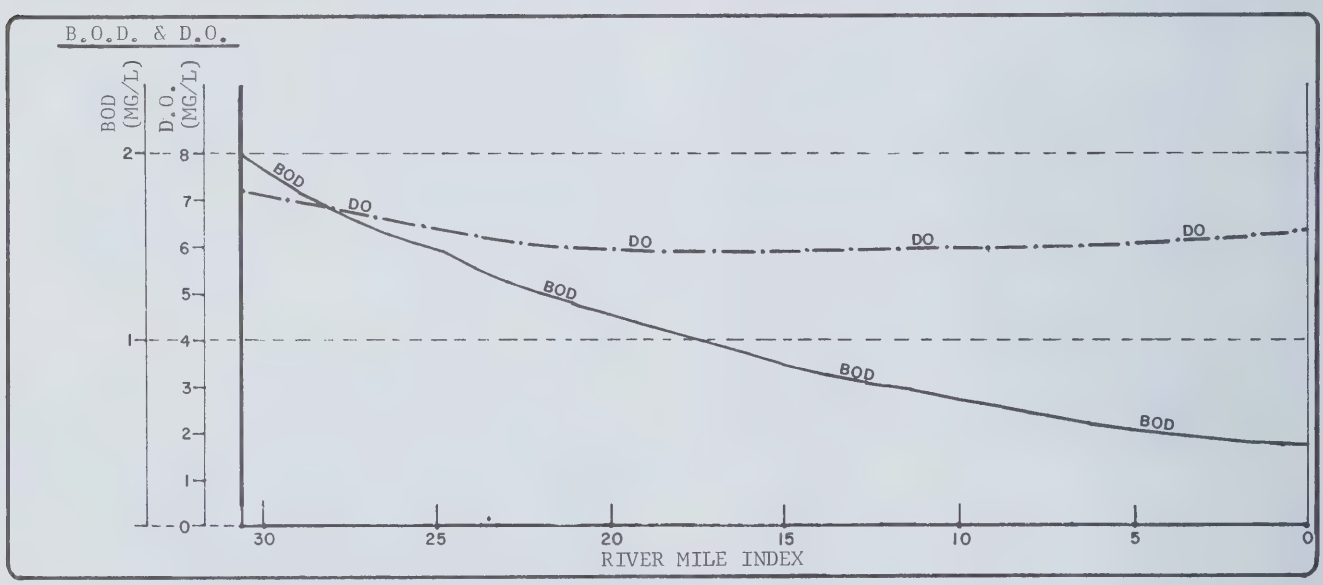
The purpose of this section is to describe official legislative controls available under local, state, and federal statutes for the control of projected growth within the LCRB. Between 1970 and 1995, it is projected another ten square miles of new urban-type development will be needed to accommodate a projected population growth of 39,000 people. The twenty-two segment basins of the LCRB vary in their ability to handle increased wastewater loads that would be created by future growth.

Although improvements definitely could be made in the governmental policy and land use controls applying to the LCRB, they presently appear to have the potential for guiding and regulating growth in a manner that would help to achieve the objectives of wastewater management.

Existing Kentucky planning enabling legislation (KRS Chapter 100) permits all cities and counties in the state to form planning commissions, prepare community plans, including land use plans, and to adopt plan controls and implementation aids. If put into operation by LCRB local government units, and if used effectively, the planning activities could guide

Exhibit 2.6g: SUMMARY OF WATER QUALITY DATA FOR CUMBERLAND RIVER





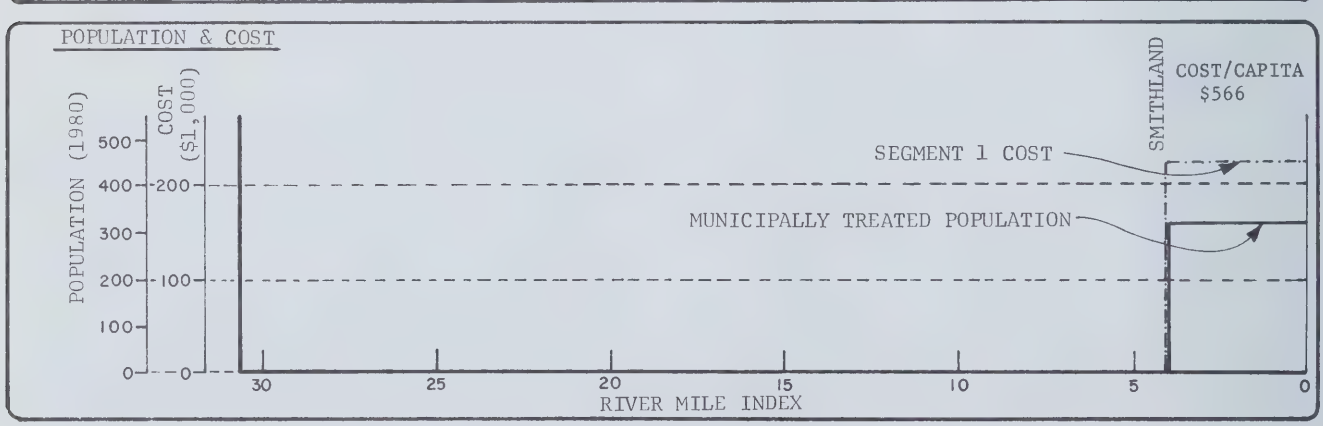
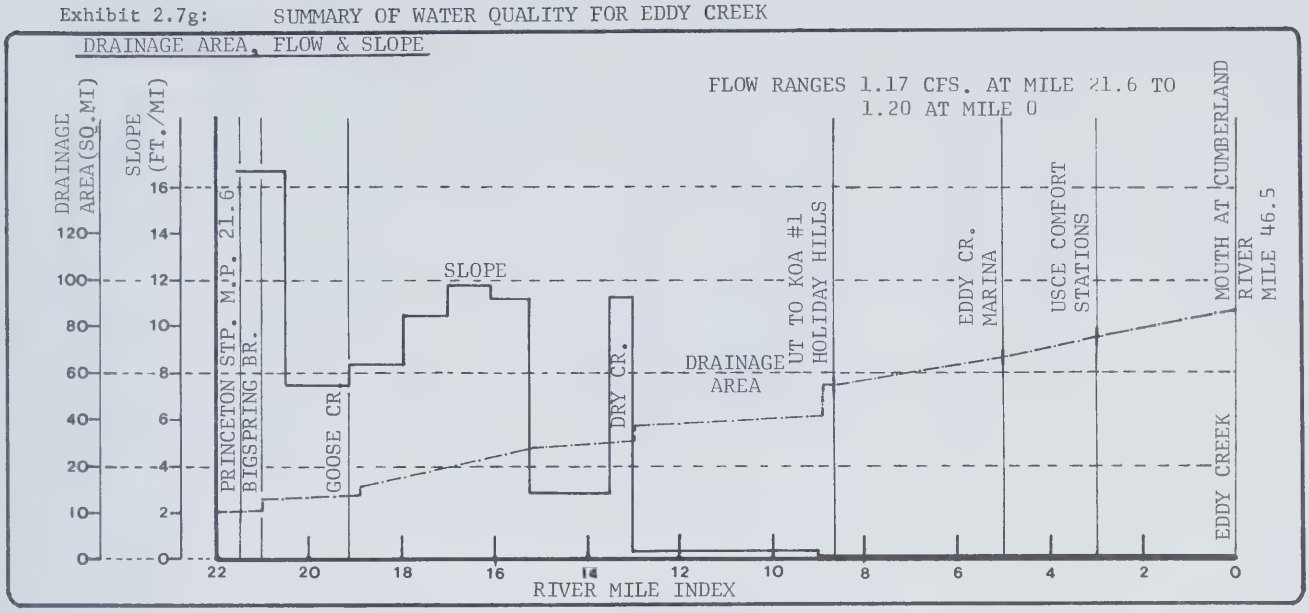
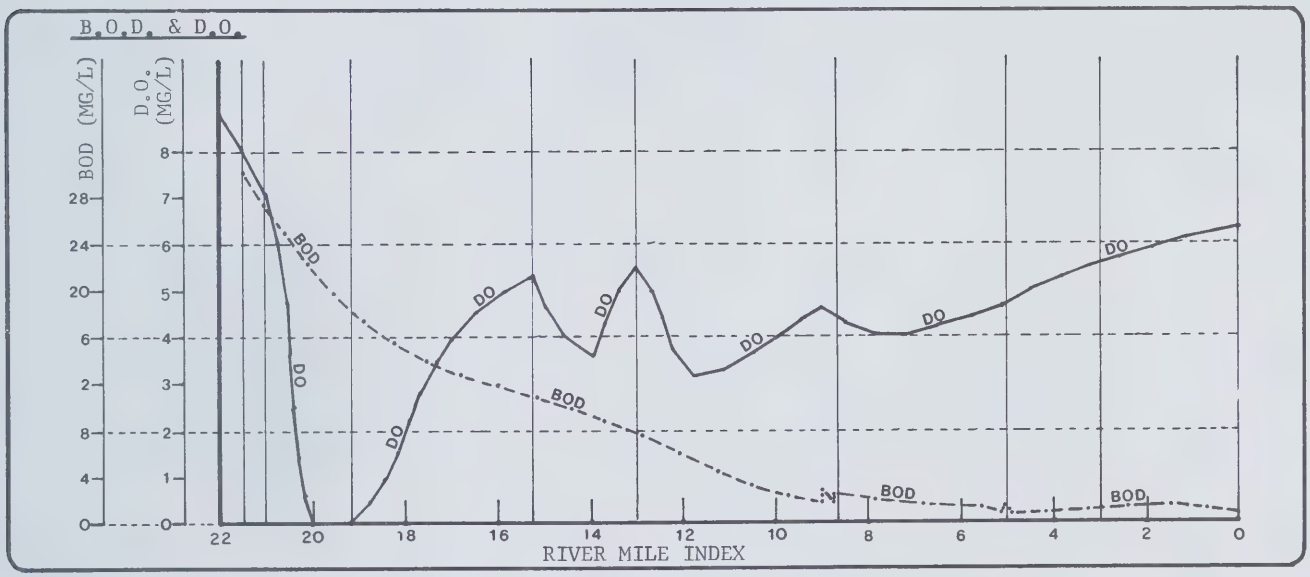


Exhibit 2.7g: SUMMARY OF WATER QUALITY FOR EDDY CREEK





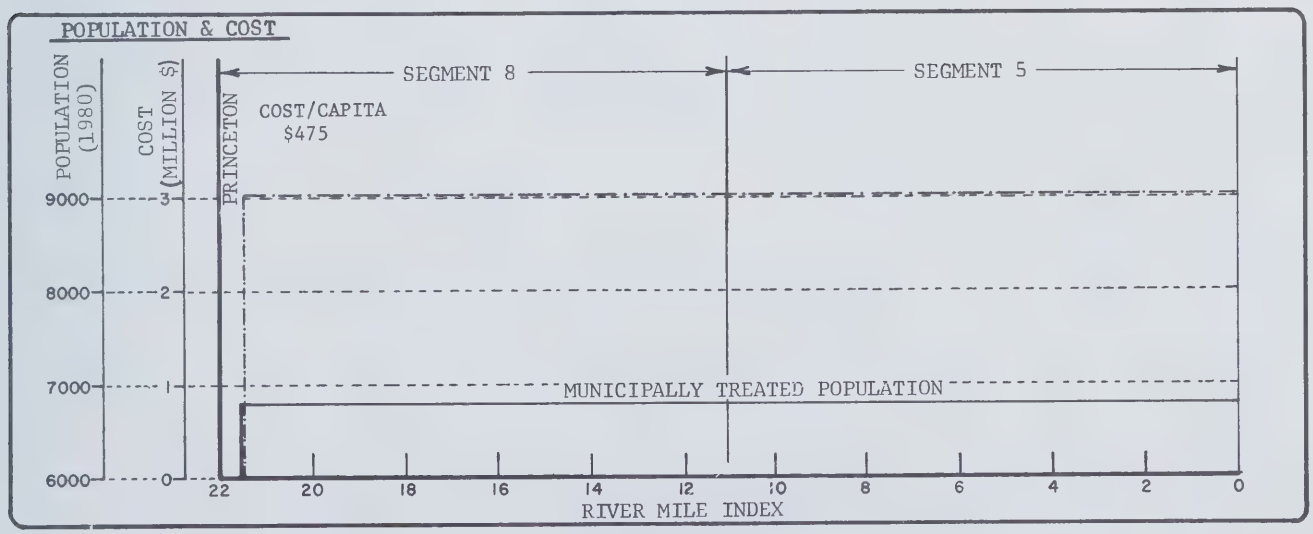
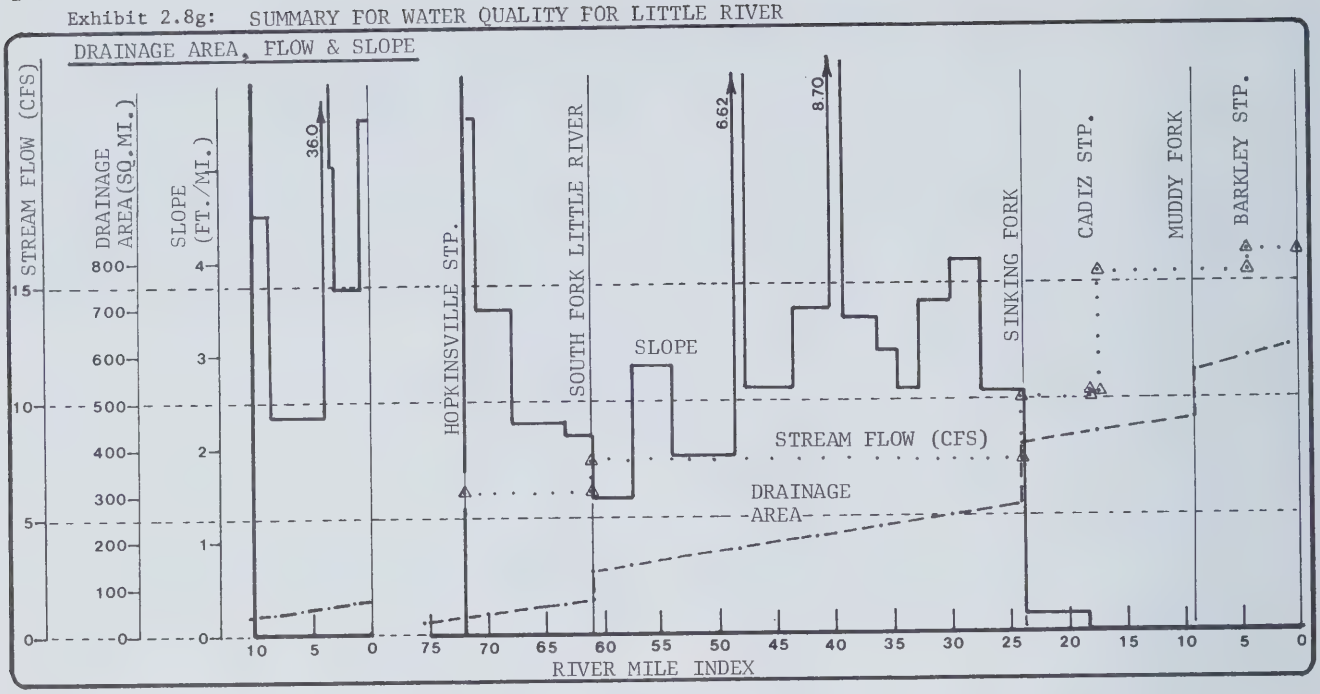
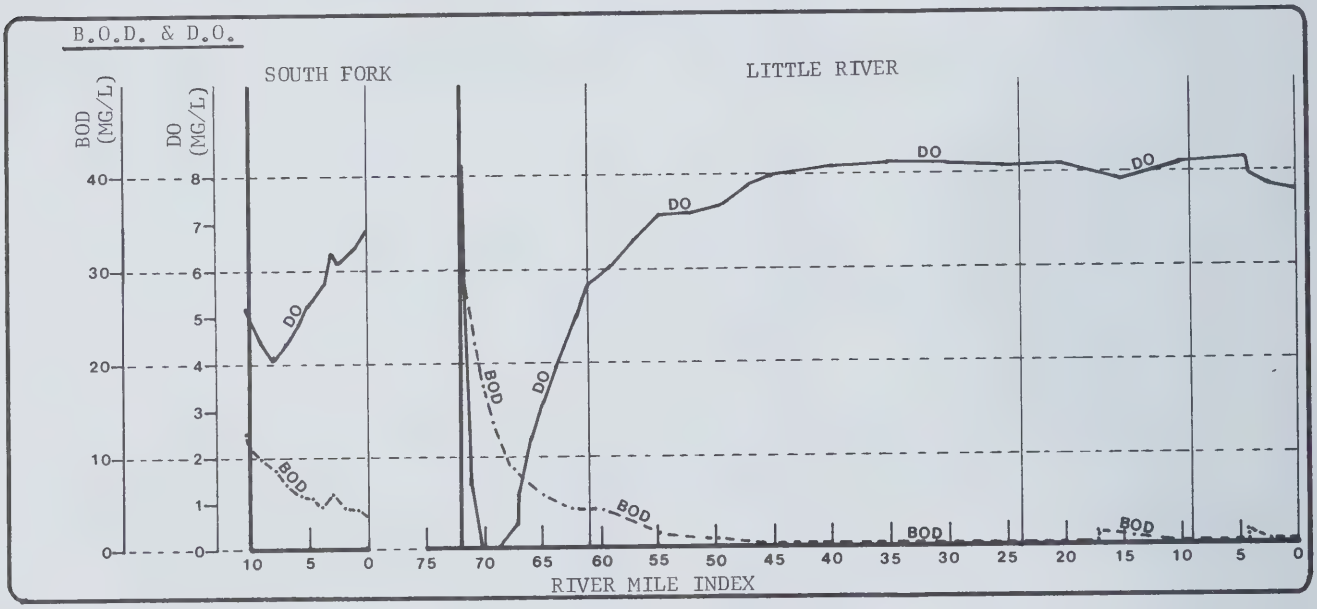


Exhibit 2.8g: SUMMARY FOR WATER QUALITY FOR LITTLE RIVER





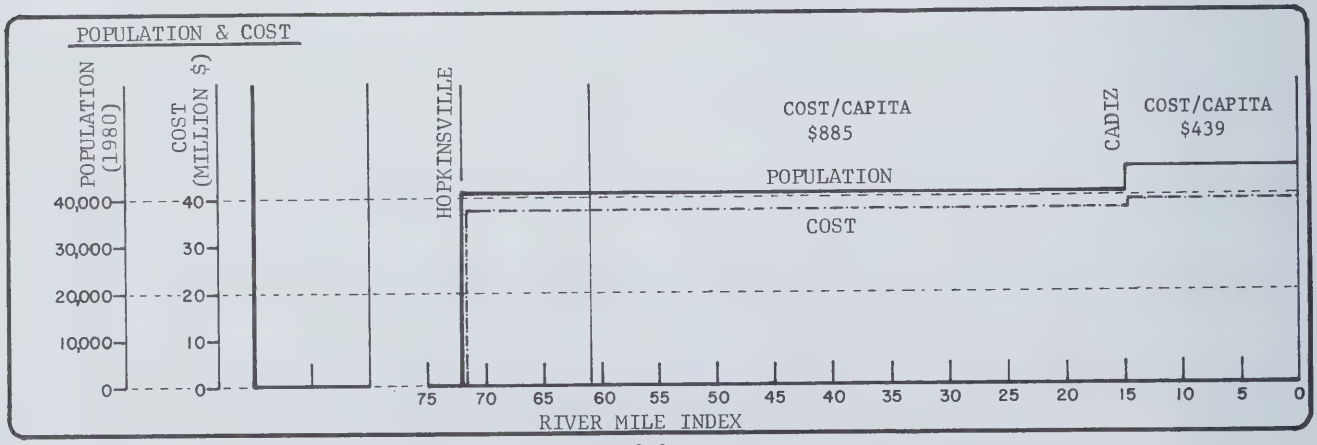


Exhibit 2.9g: SUMMARY FOR WATER QUALITY FOR RED RIVER

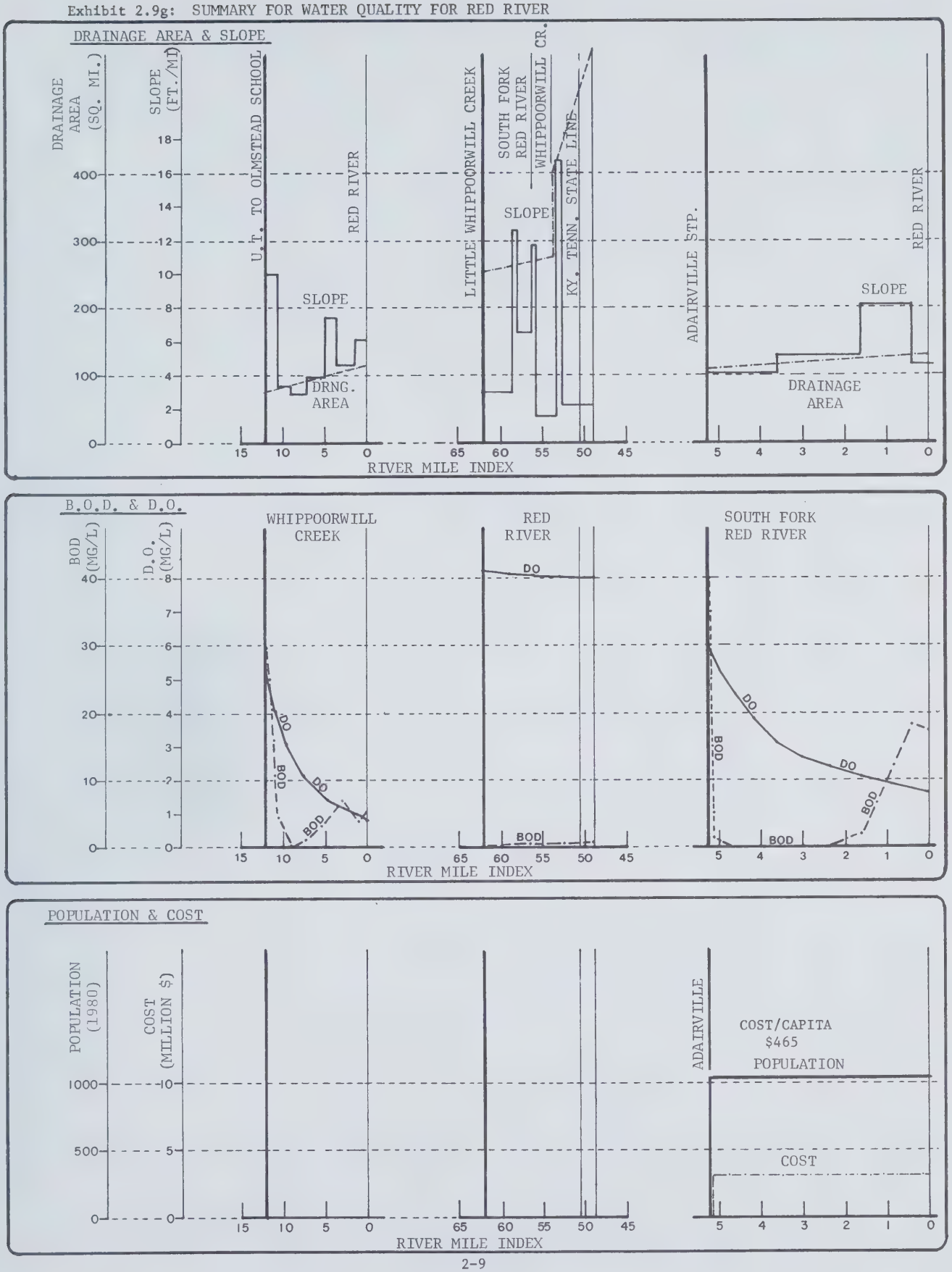


Exhibit 2.10g: SUMMARY OF WATER QUALITIES FOR BIG WEST FORK RED RIVER & TRIBUTARIES

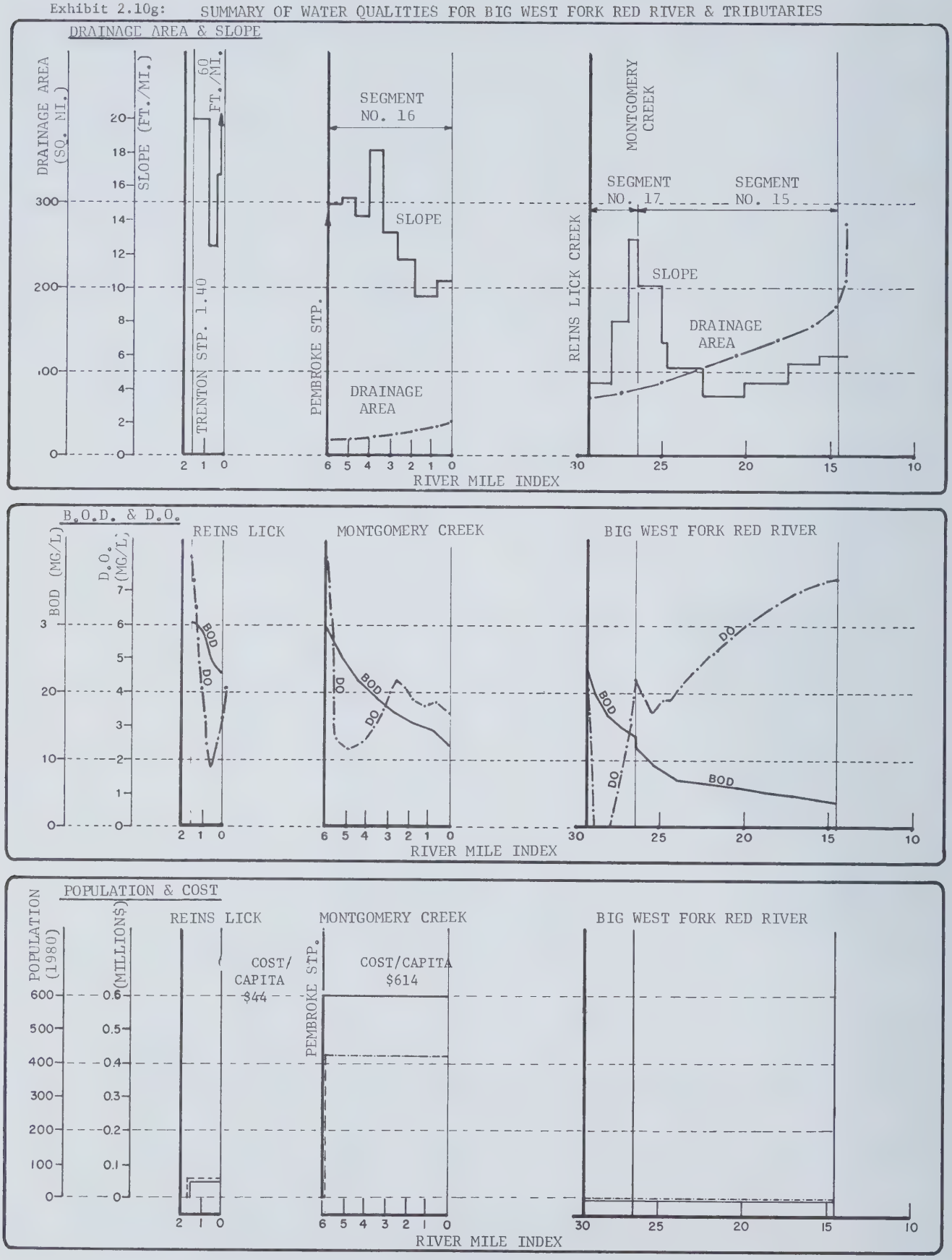
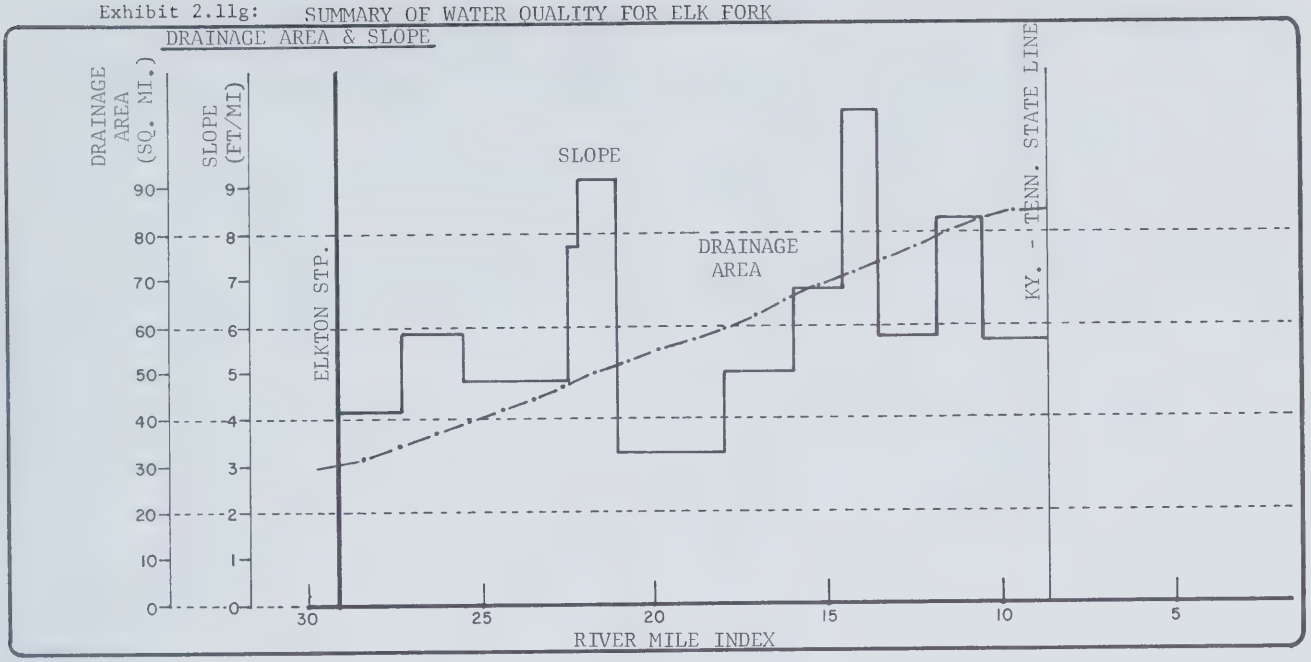
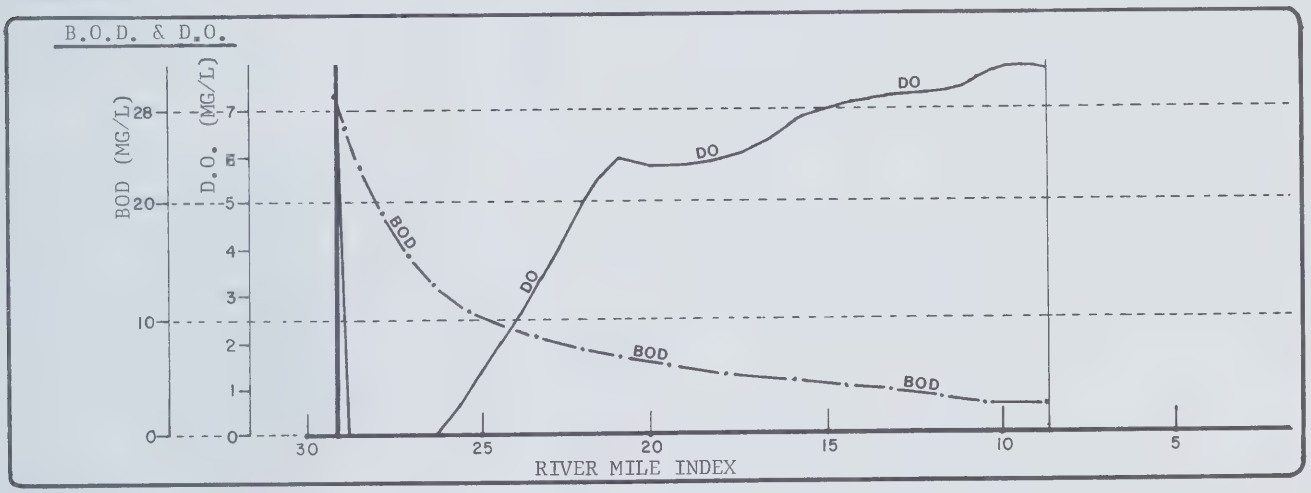
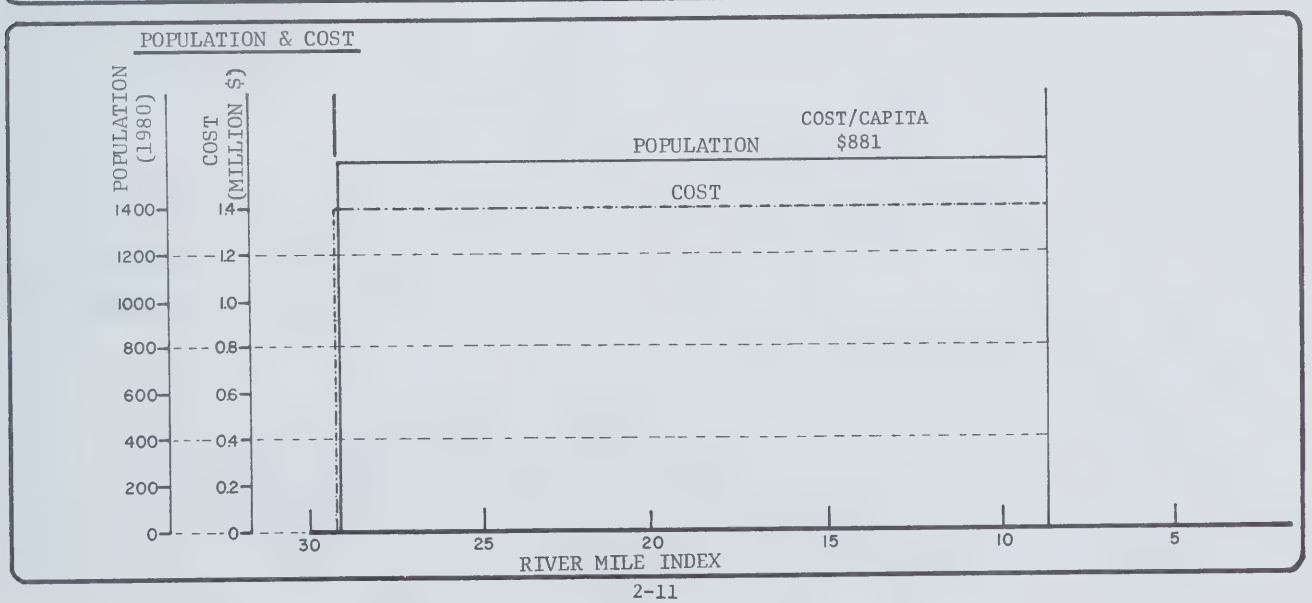


Exhibit 2.11g: SUMMARY OF WATER QUALITY FOR ELK FORK







and direct growth into the segment basins best able to accommodate increased wastewater loads.

Although the needed legislation is available, the LCRB governmental units vary in terms of the extent to which they make use of it. For instance, joint city-county planning commissions exist throughout the basin, but some have not held official meetings recently, while others have no regular meeting dates. The degree to which community plans and control devices have been prepared and adopted also varies from very good to poor. In some situations, plans and controls need to be prepared and used for the first time, and, in other cases, the work is in need of updating.

When these local government opportunities are combined with related agencies and programs at regional, state, and federal levels, the potential for proper growth guidance becomes even stronger. Improvements can, and should be, made in policy and legislative controls, but they are presently sufficient to achieve the objectives, and comply with the requirements, of Public Law 92-500.

PUBLIC PARTICIPATION

The Federal EPA guidelines for basin water quality management planning require that one or more public hearings be held, and that public participation be encouraged throughout the process. For each Kentucky river basin, public participation was encouraged by means of information and education, public involvement, and the public hearing.

For information and education, several exhibit boards containing basin data were prepared for graphic display at meetings and presentations. An informational report also was prepared and distributed at a meeting with the Pennyrile A.D.D. board. Additional copies were left with the ADD Executive Director, and the consultant distributed copies to officials in personal office trips.

Newspaper articles were prepared and distributed to LCRB newspapers by the consultant and the Public Information Office of the Department for Natural Resources and Environmental Protection. The "Summary" portion of this plan also was printed and distributed at the "citizen's workshop".

For public involvement, presentations were made to the Pennyrile ADD Board, and the Barren River ADD Board. In June, a "citizen's workshop" was held at Land Between the Lakes State Park, under the sponsorship of the Kentucky Environmental Quality Council. The consultant also made personal visits to offices of some of the local officials in the LCRB in order to provide firsthand information and secure immediate feedback.

The public hearing was the last item in the public participation process. In addition to advertising the hearing thrity days in advance, persons attending the earlier "citizen's workshop" throughout the state were encouraged to attend.

PROPOSED PLANNING GUIDANCE

The implementation of this plan will require a basic rearrangement of the present authorities and the creation of several advisory groups as proposed below. These suggestions were developed by the ten consultants who are preparing Kentucky's River Basin Plans.

.....Form a Technical Advisory Committee of persons who are well informed on the latest techniques of evaluating and solving water quality problems. The functions of this committee would be to:

.....Inform the proper state agencies (Div. of Water Quality; Environmental Management Quality Commission; etc.) with respect to the latest techniques for solving water quality problems.

.....Provide input to priority and action schedule updating.

.....Help coordinate the 303(e) continuing effort with 201 and 208 plans.

.....Decentralize the 303(e) planning effort by locating Division of Water (Quality) engineers in the respective basins to coordinate monitoring, data acquisition, priority changes or additions, localized plan and specification review, and updating of the 303(e) data for the specific basin. These regional offices could provide laboratory services for analysis of municipal domestic, and industrial discharges necessary for the compliance monitoring part of the plan implementation.

.....Form regional and statewide citizen's advisory groups. A Regional Citizen Advisory Committee would have representatives from the public sectors in the region to advise the regional basin office on the updating of the basinwide plan and priorities. One representative from each Regional Committee would be appointed to serve on a Statewide Advisory Committee to advise the Division of Water (Quality) personnel in Frankfort on the development of its Annual 106 Program Plan. These groups could provide localized input based on firsthand knowledge of the water quality in each basin.

.....Create a computerized river basin data bank within the Division of Water (Quality). This system would serve to:

.....Provide data for 201 and 208 studies within the state.

.....Aid in updating segment and facilities priorities, treatment needs, and costs on a yearly basis throughout the state.

These proposals are discussed in greater detail in the executive summary of the Kentucky River Basins Water Quality Management Plan.

Chapter III

BACKGROUND FOR THE PLAN

INTRODUCTION

Two of the important points that need to be made about the water environment of the Lower Cumberland River Basin are: (1) it exists, in its own right, as part of the physical system of nature; and (2) it provides man with a product that is vital to his daily existence.

Both points are worthy of protection and enhancement as this water quality management plan is prepared. This, in turn, requires that additional background information be developed to more fully understand each consideration.

Thus, to better understand the relationship of water to the other parts of the physical system of nature, the "physiography" portion of this chapter will discuss topography, geology, soils, surface water, groundwater, and physiographic regions.

And, to gain more insight into the present and projected use that man makes of his water environment, the middle section of this chapter will discuss population, housing, employment, and land use.

The final sections of this chapter will describe the most common methods of basin wastewater control and the existing water quality standards.

PHYSIOGRAPHY

A description of the physical geography of the L.C.R.B. would include reference to its topography, geology, soils, and surface and ground water. These features are interrelated and reflect influences of one on the other, now and throughout the history of the Earth's development.

Topography is the rise and fall of the land relative to mean sea level. Geology deals with the age and composition of rock and soil structures. Soil types are affected by the age of geologic formations and the extent to which they have weathered. Surface waters are directly related to topography and climate, and subsurface waters are affected by topography, geology, climate, and soil structures. It becomes apparent that physiography requires an overall view of the earth's surface related features. Within this chapter each pertinent area of physiography is discussed with respect to that area's influence on ground and surface water quality in the Lower Cumberland River Basin.

Physiographic Regions

Kentucky has a land surface of 40,109 square miles, forming essentially an eroded plateau that slopes gradually to the southwest. The state is divided into six major physiographic regions which are further subdivided according to significant variations.

The Lower Cumberland River Basin lies in two of these physiographic regions, The Pennyroyal Region, and the Cumberland-Tennessee Rivers Area as shown by Exhibit 3.1m.

The Pennyroyal Region

The Pennyroyal Region is one of the largest physiographic regions in Kentucky, comprising nearly 30 percent of the state. Much of this region has uniform surface features, but parts of it vary considerably. The Western Pennyroyal, Sandstone-Shale-Limestone and Limestone Areas of the Pennyroyal Region contain most of the Lower Cumberland River Basin as shown in Exhibit 3.1m. Much of the terrain in this area is undulating to rolling, but in the vicinity of streams or underground drainage sections, it is often "karsted"---which means rough and hilly topography, with sinkholes, subsurface drainage, and limestone caverns.

The Cumberland-Tennessee Rivers Area

The Cumberland-Tennessee Rivers Area is the smallest physiographic region in the state. Its surface features are hilly and rough, except for the flood plains along the Cumberland and Tennessee Rivers. This area includes Lake Barkley and Kentucky Lake and is becoming increasingly more important for commercial and recreational uses.

Topography

The Lower Cumberland River Basin ranges in elevation from 302 feet above mean sea level at the confluence of the Cumberland and Ohio Rivers to 863 feet at Pine Knob in Christian County. Mean elevation above sea level is approximately 500 feet.

The areas in Lyon and Trigg Counties surrounding Lake Barkley could be classified as hilly to mountainous. The remainder of the Basin exhibits rolling to hilly topography, and some areas in the Eastern part of the Basin are relatively flat, causing numerous small ponds and fair to moderate surface drainage.

Karst topography is common throughout the Basin and many small streams flow underground through caverns formed in the limestone prevalent in this area. Likewise, many springs surface to form streams from underground drainage systems. This karst condition complicates the evaluation of stream water quality in this area since several potentially hazardous domestic and industrial discharges flow underground into the ground water system. A karst topography such as this also creates a potential for contamination of well water due to septic tank leaching fields.

Geology

The Lower Cumberland River Basin lies predominantly within the Mississippian Plateau geological region which overlaps the Pennyroyal Physiographic Region. The Mississippian Plateau is divided into two major areas, the Mammoth Cave Plateau and the Lower Pennyroyal Plateau. The Pennyroyal Plateau is underlain by fairly pure limestone with localized cherty areas predominantly thick bedded. The structure under the Mammoth Cave Plateau is limestone and shale. The limestone occurs in varying bed thicknesses while the shale appears most often in a lens formation. Surface rocks, are sandstone, siltstone, and conglomerates.

The thick limestone beds under the Mississippian Plateau are readily soluble in ground water and a substantial underground drainage system has developed. Sinkholes and springs occur frequently in this area, and wells sunken in this area normally produce adequate water for home use.

Unconsolidated deposits of gravel, sand, silt, and clay occur in the Land Between The Lakes area. This area is moderately rough to steep with timber growth predominating.

In Crittenden, Caldwell and Livingston Counties, a system of faults has produced discontinuous outcrops and dips. This area produces fluorspar along the fault lines, and various other minerals have been mined north of the Cumberland River Basin.

Soils

All soils are the result of five major influences: climate, living organisms, parent materials, topography, and time. Except for the most recent alluvial deposits (soil carried downstream by flooding), most of Kentucky's soils developed under a forest cover with a moderate climate. Differences in Kentucky soils are primarily due to different parent materials and topography.

Soil associations in the Lower Cumberland River Basin have been identified from maps prepared by the U.S. Department of Agriculture, Soil Conservation Service. A summary of the soils, their location, and their properties with respect to water quality may be found in Exhibit 3.2t and 3.3m.

Soil Association numbers in Exhibit 3.2t correspond to those in Exhibit 3.3m and also to the soil conservation maps (referenced in the Bibliography). These exhibits give some insight into the limitations of certain soils for septic tank waste disposal, ground surface sewage disposal, and the potential of each soil for erosion and/or flooding.

Soils of the Western Pennyroyal, Sandstone-Shale-Limestone Area

Westmoreland soils, with a small amount of Muskingum and Hector soils, occupy the steeper slopes. Several soil series are important in the parts suited for agriculture. Some, such as the Tilsit, are derived from thin loess over sandstone and shale residuum; Pearman soils resemble the Tilsit, but are partly derived from limestone. Both of these series have mottled, fairly tight lower subsoils. Their well drained counterparts are the Wellston and Christian soils. Poorly drained soils, chiefly the Johnsburg and Mullins series, occupy most of the flat uplands. The undulating to gently rolling uplands are suitable for cultivation with liberal additions of lime and fertilizer. The level, wet lands need draining, and are only fairly productive after addition of lime and fertilizer. Rolling areas are suitable for pasture with careful management.

There is considerable bottom land, and some of the alluvial soil series, such as the Staser, are well drained and productive. Others, such as the Prader and Atkins, are wet and suited only for hay and pasture unless drained. The Sandstone-Shale-Limestone Area is approximately 40% forested, 35% cropland, and 25% pastureland.

Soils of the Western Pennyroyal, Limestone Area

Pembroke, Decatur, Crider, and Cookeville soils are dominant in the undulating portions. All are well drained, moderately fertile soils. Surface soils are brownish silt loams, and are reddish, moderately thick, and high in clay, but of good structure. They are derived from loess and limestone residuum, and are well suited to cultivation, responding well to lime and fertilizer. Baxter and Ashburn soils, derived from cherty limestone, are dominant in the strongly karsted parts and common elsewhere. These are less fertile soils and more difficult to cultivate because of abundant chert and more steep and irregular slopes. Small patches of poorly drained gray Guthrie soils occur in several places. This Limestone Area is approximately 10% forested, 75% cropland, and 15% pastureland.

Soils of the Cumberland-Tennessee Rivers Area

Principal soils are the Brandon, Lax, Mountview and Guin. All have cherty or gravelly subsoils, or underlying materials, and are partly derived from shallow loess. Guin soils are very gravelly and droughty, the Brandon and Mountview are thicker and well drained, while the Lax soils are moderately well drained with compact, slowly permeable lower subsoils just above the gravel beds. All are of low fertility and strongly acid.

Most of the upland soils that are suited for cultivation and pasture are in the northern part of the area where the loess is thickest, and the slopes less steep. The well drained Huntington soils of the bottoms along the Cumberland River are the best agricultural soils. Associated with them are some less well drained and less productive soils, and some that are too wet to be cultivated. This area is approximately 75% forested, 10% cropland, and 15% pastureland.

Surface and Groundwater

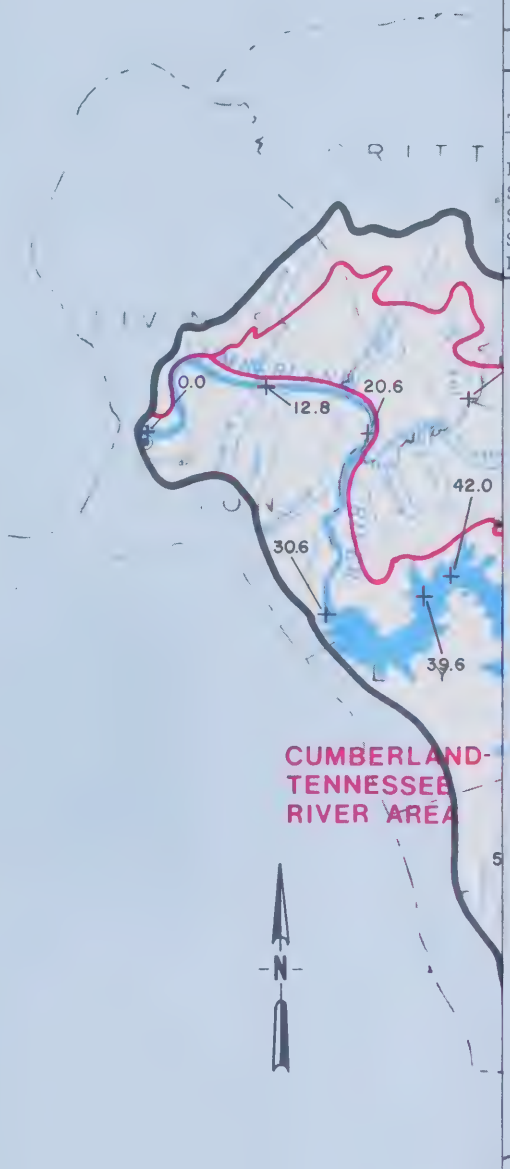
Natural surface drainage depends on many related factors, including topography, geology, soil types, and climate in the area under consideration. Streams in the Lower Cumberland River Basin are primarily intermittent in the summer months, and seven day-ten year low flows are equal to zero for streams draining many of the smaller drainage areas. A seven day-ten year low flow is the lowest average stream flow which can be expected to occur in any seven consecutive days in a ten year time span. Low flow volumes in

ter Quality

e	Sulphate (PPM)
)	10-350
)	10-350
)	10-350

Type

L -Limestone
Sh-Shale
S -Sandstone
Si-Siltstone
Lo-Loess



LOWER CUMBERLAND RIVER BASIN

EXHIBIT 3.1m

PHYSIOGRAPHIC REGIONS

LEGEND

PHYSIOGRAPHIC REGION BOUNDARY

5 0 10 20

GRAPHIC SCALE IN MILES

Base Data: U. S. Geological Survey

KENTUCKY WATER QUALITY MANAGEMENT PLAN

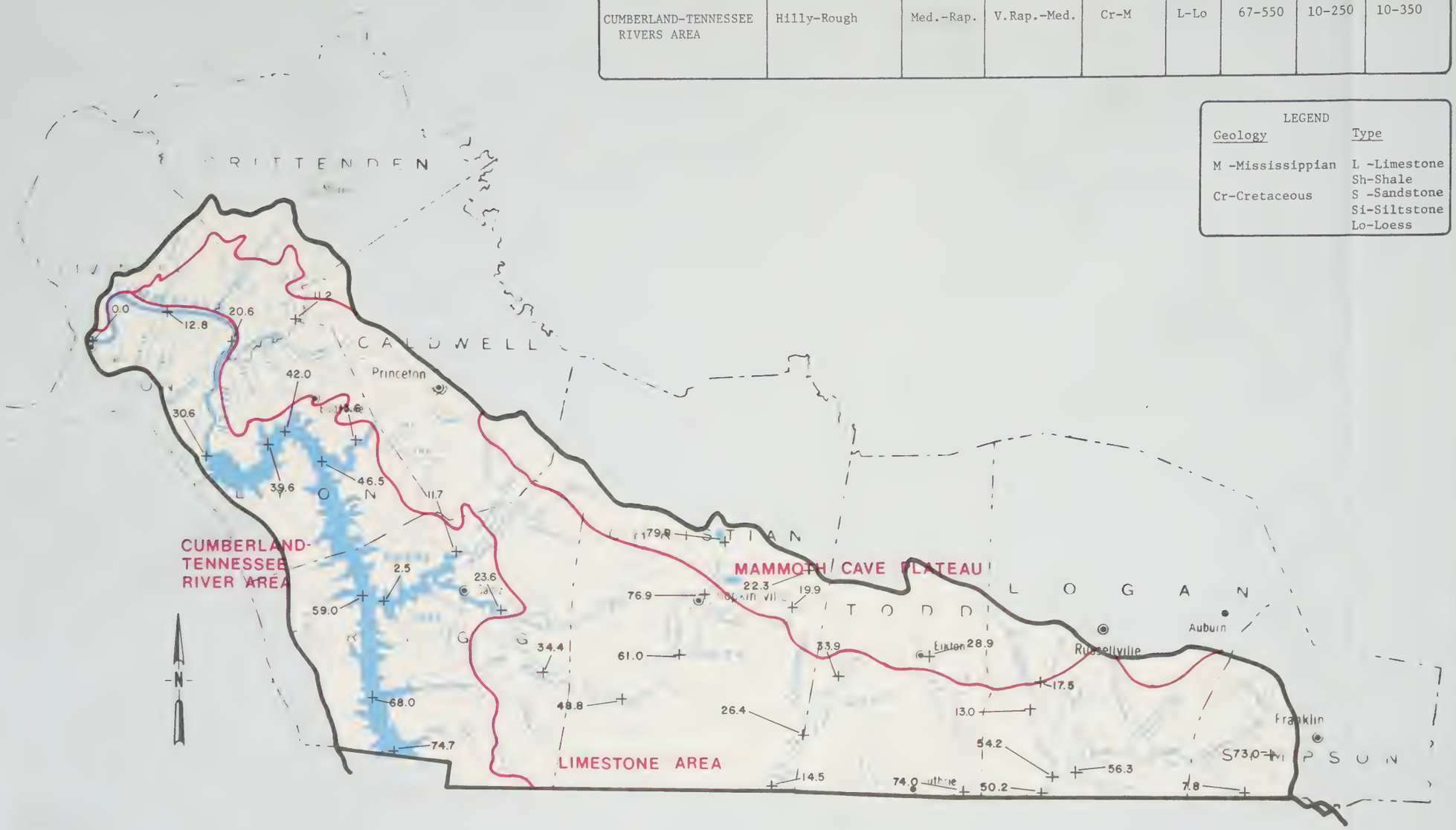
Prepared for Division of Water Quality
KENTUCKY DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION

G. REYNOLDS WATKINS CONSULTING ENGINEERS, INC.
Lexington, Bowling Green & Louisville, Kentucky

Physiographic Region	Topography	Drainage		Geology		General Groundwater Quality		
		Run-Off	Internal	Formation	Type	Hardness (PPM)	Chloride (PPM)	Sulphate (PPM)
PENNYROYAL REGION								
Mammoth Cave Plateau	Karst-Undulating	Med.-Rap.	Slow-Med.	M	L-Sh-S	67-550	10-250	10-350
Limestone Area	Undulating	Med.	Med.	M	L-Lo	67-550	10-250	10-350
CUMBERLAND-TENNESSEE RIVERS AREA	Hilly-Rough	Med.-Rap.	V.Rap.-Med.	Cr-M	L-Lo	67-550	10-250	10-350

LEGEND

Geology	Type
M -Mississippian	L -Limestone
	Sh-Shale
Cr-Cretaceous	S -Sandstone
	Si-Siltstone
	Lo-Loess



LOWER CUMBERLAND RIVER BASIN

EXHIBIT 3.1m

PHYSIOGRAPHIC REGIONS

LEGEND

PHYSIOGRAPHIC REGION BOUNDARY

5 0 10 20

GRAPHIC SCALE IN MILES

Base Data: U.S. Geological Survey

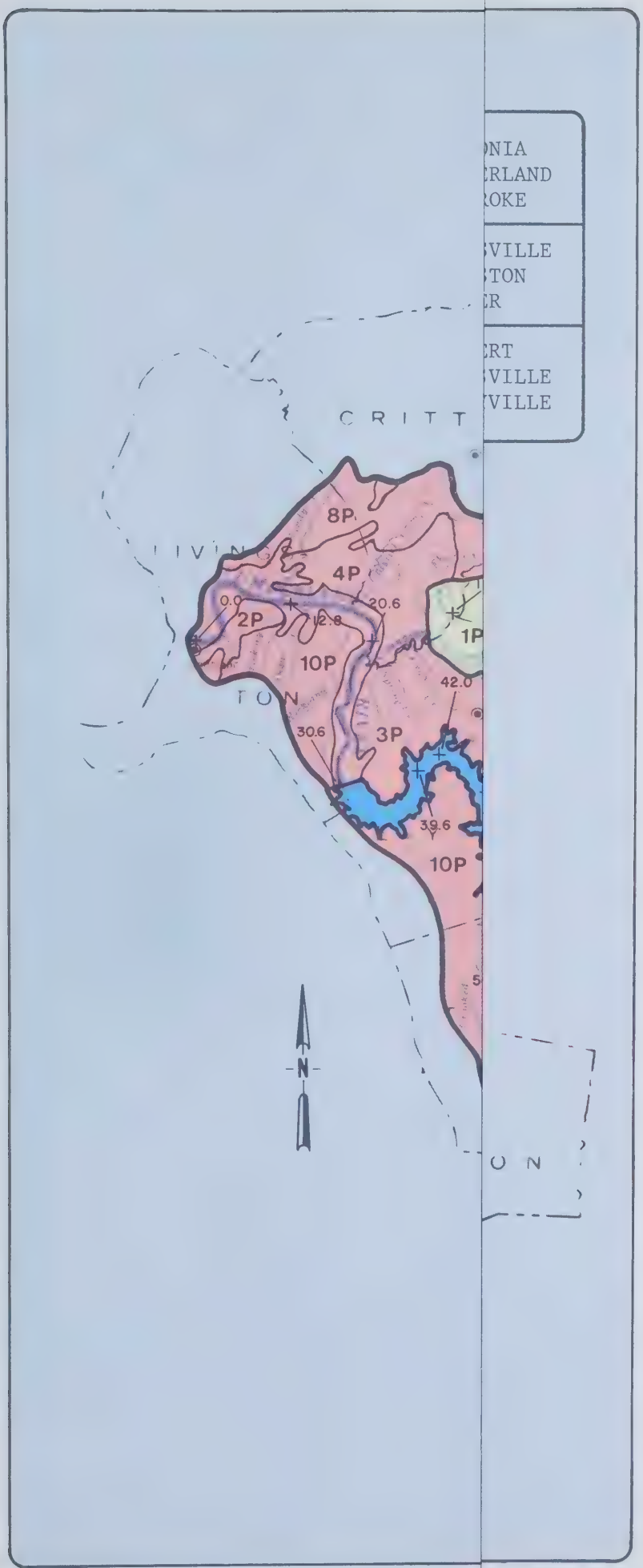
KENTUCKY WATER QUALITY MANAGEMENT PLAN

Prepared for Division of Water Quality

KENTUCKY DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION

G. REYNOLDS WATKINS CONSULTING ENGINEERS, INC.

Lexington, Bowling Green & Louisville, Kentucky



LOWER CUMBERLAND RIVER BASIN

EXHIBIT 3.3m

SOIL INTERPRETATION

LEGEND

3P SOIL ASSOCIATION NUMBER

SOIL ASSOCIATIONS

SEPTIC FIELD LIMITATIONS

- SLIGHT
- MODERATE
- SEVERE

5 0 10 20

GRAPHIC SCALE IN MILES

Base Data: U.S. Geological Survey

KENTUCKY WATER QUALITY MANAGEMENT PLAN

Prepared for Division of Water Quality

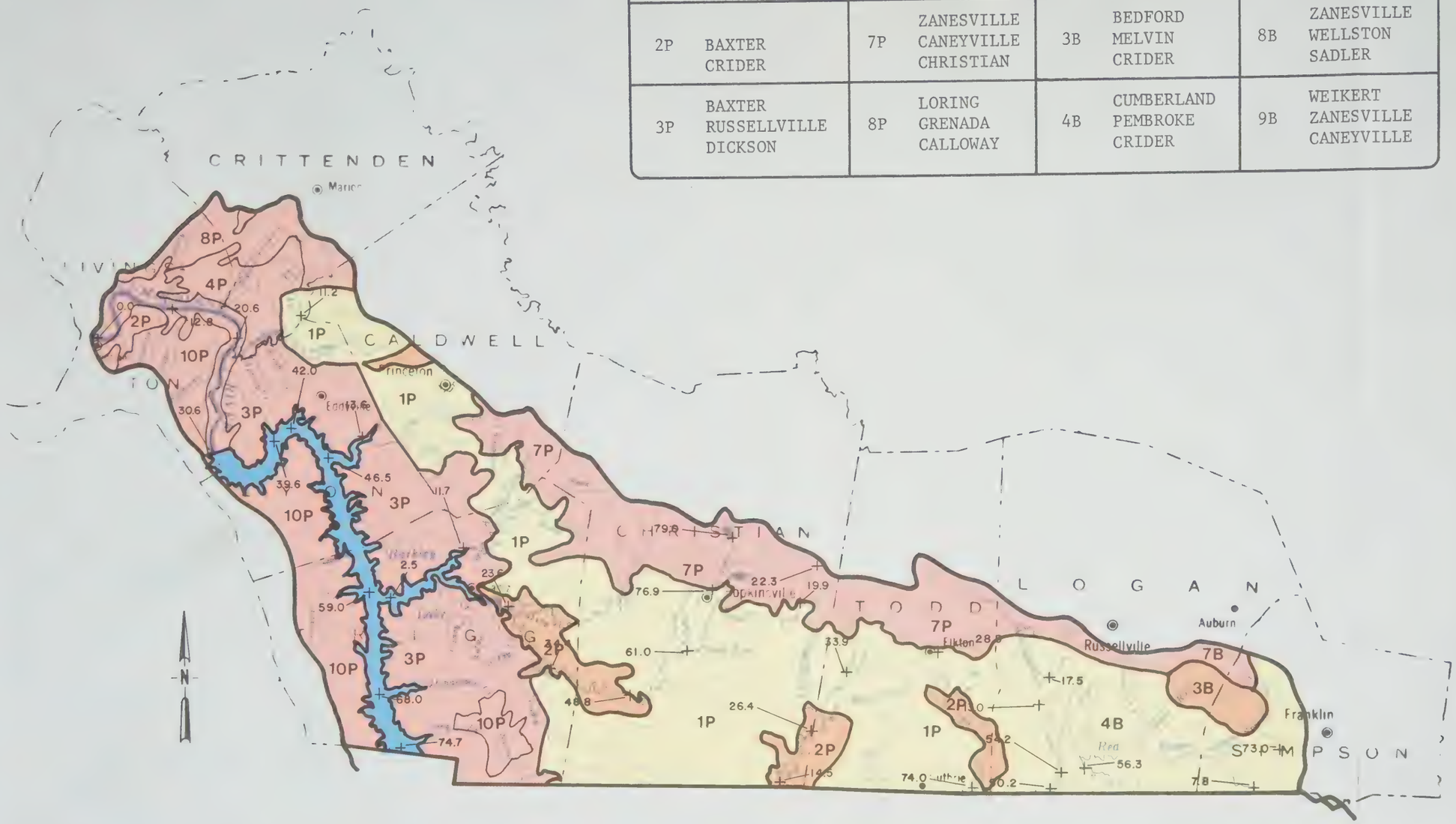
KENTUCKY DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION

G. REYNOLDS WATKINS CONSULTING ENGINEERS, INC.

Lexington, Bowling Green & Louisville, Kentucky

SOIL ASSOCIATIONS LEGEND

1P	CRIDER PEMBROKE BEDFORD	4P	BAXTER LORING MEMPHIS	10P	GUIN BRANDON LAX	7B	FREDONIA CUMBERLAND PEMBROKE
2P	BAXTER CRIDER	7P	ZANESVILLE CANEYVILLE CHRISTIAN	3B	BEDFORD MELVIN CRIDER	8B	ZANESVILLE WELLSTON SADLER
3P	BAXTER RUSSELLVILLE DICKSON	8P	LORING GRENADA CALLOWAY	4B	CUMBERLAND PEMBROKE CRIDER	9B	WEIKERT ZANESVILLE CANEYVILLE



LOWER CUMBERLAND RIVER BASIN

EXHIBIT 3.3m

SOIL INTERPRETATION

LEGEND

3P SOIL ASSOCIATION NUMBER

SOIL ASSOCIATIONS

SEPTIC FIELD LIMITATIONS

- SLIGHT
- MODERATE
- SEVERE

5 0 10 20

GRAPHIC SCALE IN MILES

Base Data: U.S. Geological Survey

KENTUCKY WATER QUALITY MANAGEMENT PLAN

Prepared for Division of Water Quality

KENTUCKY DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION

G. REYNOLDS WATKINS CONSULTING ENGINEERS, INC.

Lexington, Bowling Green & Louisville, Kentucky

Exhibit 3.2t-Soils in the LCRB

Map No.	Soil Association	Percent of Association	Dominant Slope %	Septic Tank* Absorption Field (2-6% Slopes) Limitations	Land Application of Wastewater (2-6% Slopes) Limitations	Hydrologic Soil Group**	Potential Sediment Runoff ***
	CRIDER	35	0-6	Slight	Slight	B	Low
1P	PEMBROKE	28	0-6	Slight	Slight	B	Low
	BEDFORD	16	0-6	Severe(P)	Severe(P)	C	Medium
2P	BAXTER	31	6-20	Severe(S,D)	Severe(S)	B	Medium
	CRIDER	37	0-6	Slight	Slight	B	Low
	BAXTER	57	6-20	Severe(S,D)	Severe(S)	B	Medium
3P	RUSSELLVILLE	26	2-12	Severe(P)	Severe(P)	C	Medium
	DICKSON	16	0-6	Severe(P)	Severe(P)	C	Medium
	BAXTER	36	6-20	Severe(S,D)	Severe(S,D)	B	Medium
4P	LORING	16	2-12	Severe(P)	Mod.-Severe(P,S)	C	Medium
	MEMPHIS	12	2-30	Severe(S)	Severe(S)	B	Medium
	ZANESVILLE	32	2-12	Severe(P)	Severe(P)	C	Medium
7P	CANEYVILLE	22	12-30	Severe(S,D)	Severe(P,S)	C	High
	CHRISTIAN	12	6-20	Severe(P,S)	Severe(P,S)	C	Medium
	LORING	29	2-12	Severe(P)	Mod.-Severe(P,S)	C	Medium
8P	GRENADA	24	2-6	Severe(P)	Severe(P)	C	Medium
	CALLOWAY	10	0-2	Severe(P,F)	Severe(P)	C	Medium
	GUIN	52	12-30	Severe(S)	Severe(S,P)	A	High
10P	BRANDON	19	2-20	Moderate(P)	Mod.-Severe(S)	B	Medium
	LAX	10	0-12	Moderate(P)	Severe(P)	C	Medium
	BEDFORD	40	0-12	Severe(P)	Severe(P)	C	Medium
3B	MELVIN	25	0-12	Severe(F)	Severe(F)	D	Medium
	CRIDER	20	0-12	Slight	Slight-Mod.(S)	B	Medium
	CUMBERLAND	39	2-20	Severe(P,S)	Severe(S,P)	B	Medium
4B	PEMBROKE	34	0-12	Moderate(S)	Slight-Mod.(S)	B	Medium
	CRIDER	16	0-12	Slight	Slight-Mod.(S)	B	Medium
	FREDONIA	40	6-25	Severe(D)	Severe(S,P)	C	Medium
7B	CUMBERLAND	23	2-20	Severe(P,S)	Severe(S,P)	B	Medium
	PEMBROKE	19	0-12	Moderate(S)	Slight-Mod(S)	B	Low
	ZANESVILLE	45	2-12	Severe(P)	Severe(P)	C	Medium
8B	WELLSTON	29	2-30	Severe(S)	Slight-Severe(S)	B	High
	SADLER	20	0-10	Severe(P)	Severe(P)	C	Medium
	WEIKERT	30	12-50	Severe(S,D)	Severe(P)	D	High
9B	ZANESVILLE	18	2-12	Severe(P)	Severe(P)	C	Medium
	CANEYVILLE	13	6-35	Severe(P,S,D)	Severe(P,S)	C	High

P - Pennyrile A.D.D. B - Barren River A.D.D.

* Limitations: P=Percolation; S=Slope; D=Shallow Depth; F=Flooding

**

Hydrologic Soil Group	Infiltration Rate
A	High
B	Moderate
C	Slow
D	Very Slow

*** Interpretation for Sediment Run-Off is based on dominant slope and hydrologic soil group only. Rainfall Factor, vegetative cover and conservation practices are held constant.

Map numbers correspond to those used on the General Soil Map for the respective Area Development District

the Basin range from "zero cubic feet per second (0-cfs)" in the headwaters of the streams to greater than 5,000 (cfs) at Barkley Dam (See Exhibit 3.4m). Average flow in the Cumberland River near its confluence with the Ohio River at Smithland, Kentucky is greater than 27,000 (cfs).

Major streams in the Lower Cumberland River Basin include the Little River, West Fork of the Red River, the Red River, and the Cumberland River. Tributaries to these streams drain the Basin and feed the Cumberland River flowing into Lake Barkley. Both water quality and stream flow monitoring stations have been established at several locations within the Basin by the Kentucky Department for Natural Resources and Environmental Protection. Likewise, gauging stations have been established and operated by the U.S. Geological Survey and the U.S. Army Corps of Engineers on the Cumberland River and the Little River. Water quality data has been compiled for the Basin and is included in Appendix A-1.

Ground water supply in the LCRB varies in its ability to provide domestic well-water supply, although the majority of the area generally can support a drilled or dug well yielding at least 500 gallons per day (gpd). Flows are lowest in late summer and early fall, caused by seasonal reductions in ground water availability.

Some of the area capable of providing this water supply include: (1) most areas in the northern part of the LCRB yield in excess of 500 gpd, with many wells producing over 100,000 gpd; (2) areas in Logan and Simpson Counties generally yield in excess of 500 gpd, and will support domestic wells with power pumps; and (3) in areas immediately adjacent to major streams, the yield is at least 10,000 gpd.

Areas not having this capability include: (1) the Land Between the Lakes, where wells generally do not yield the 100 gpd needed for domestic supply, due to the thick bedded limestone prevalent in the area; and (2) areas in northeastern Christian County and northern Todd County, which also generally provide less than the needed 100 gpd.

The karst topography of the major portion of the Basin encourages a great number of underground solution channels, creating a vast network of underground flow similar to the stream networks of the surface water system. This is evident by observing the number of small streams which flow into sinkholes or caverns, and also by the number of springs which occur in the Limestone Area.

The hardness of the groundwater in the Lower Cumberland River Basin varies in relationship to the geologic water bearing strata. Exhibit 3.5m shows the approximate locations of three different geologic areas and the differences in well-water hardness in these areas. The levels of groundwater hardness noted in this exhibit refer to the following hardness values:

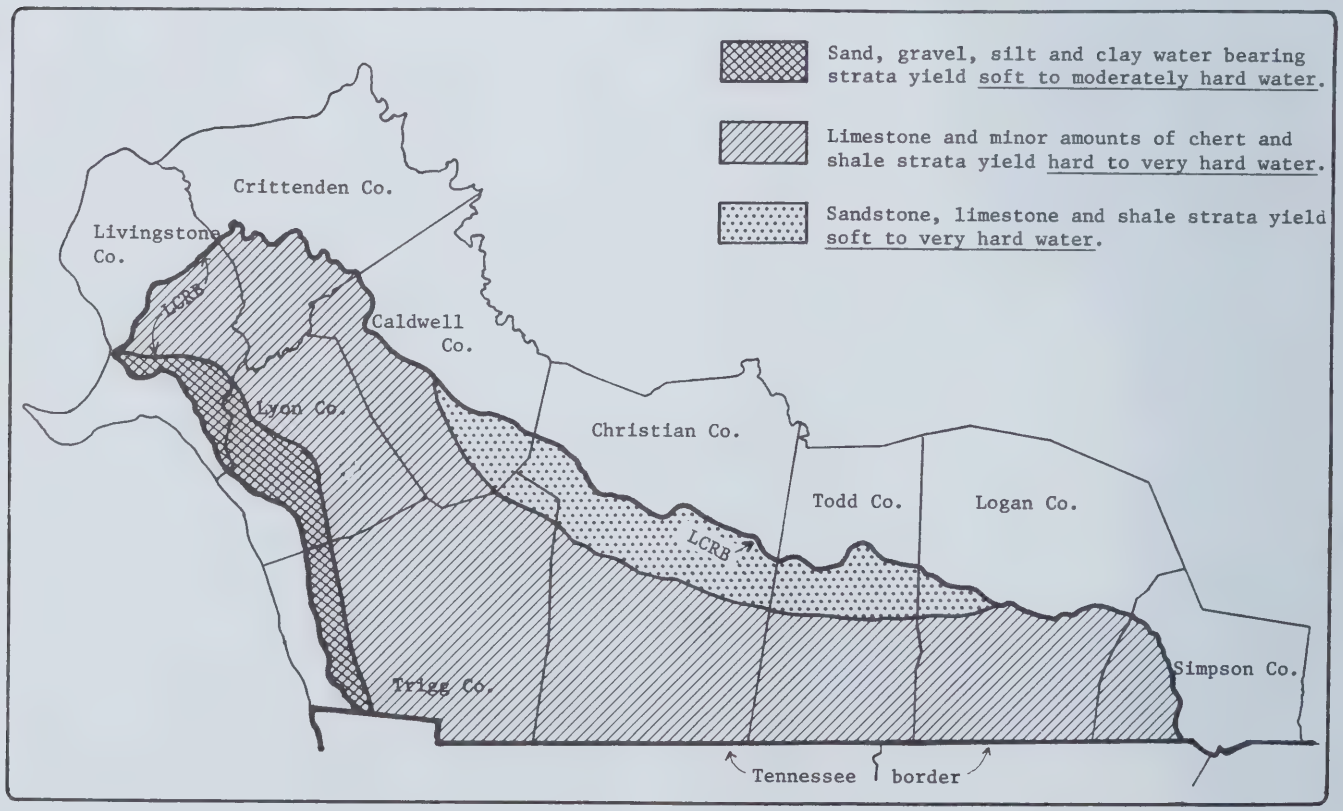
..Soft Water, hardness 0-60 parts per million (ppm)

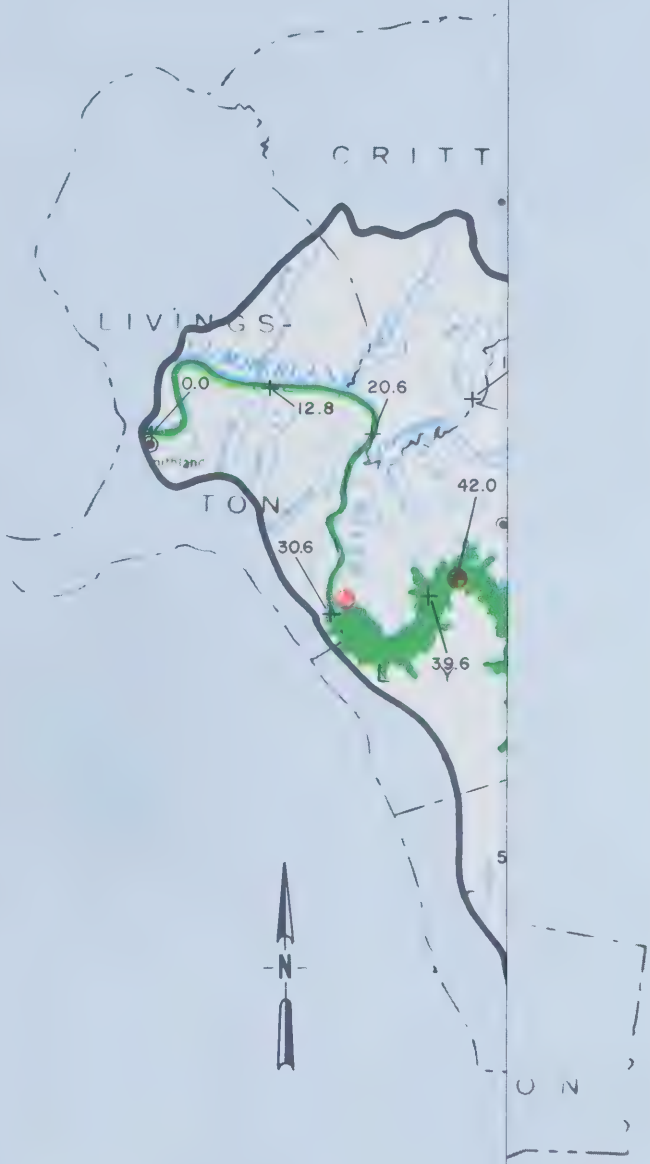
..Moderately Hard Water, hardness 60-120 ppm

..Hard Water, hardness 120-200 ppm

..Very Hard Water, hardness more than 200 ppm

Exhibit 3.5m: Well Water Hardness Due To Geologic Strata In Lower Cumberland River Basin


Sand, gravel, silt and clay water bearing strata yield soft to moderately hard water.
Limestone and minor amounts of chert and shale strata yield hard to very hard water.
Sandstone, limestone and shale strata yield soft to very hard water.
Crittenden Co.
Livingstone Co.
LCRB
Caldwell Co.
Lyon Co.
Christian Co.
Todd Co.
Logan Co.
LCRB
Trigg Co.
Simpson Co.
Tennessee border



LOWER CUMBERLAND RIVER BASIN

EXHIBIT 3.4m

STEAM FLOW CHARACTERISTICS

LEGEND

LOW FLOW BOUNDARIES (APPROXIMATE)

- 0.10-1 (CFS)
- 1-10 (CFS)
- GREATER THEN 10 CFS

- PRIMARY MONITORING STATION
- SECONDARY

5 0 10 20

GRAPHIC SCALE IN MILES

Base Data: U.S. Geological Survey

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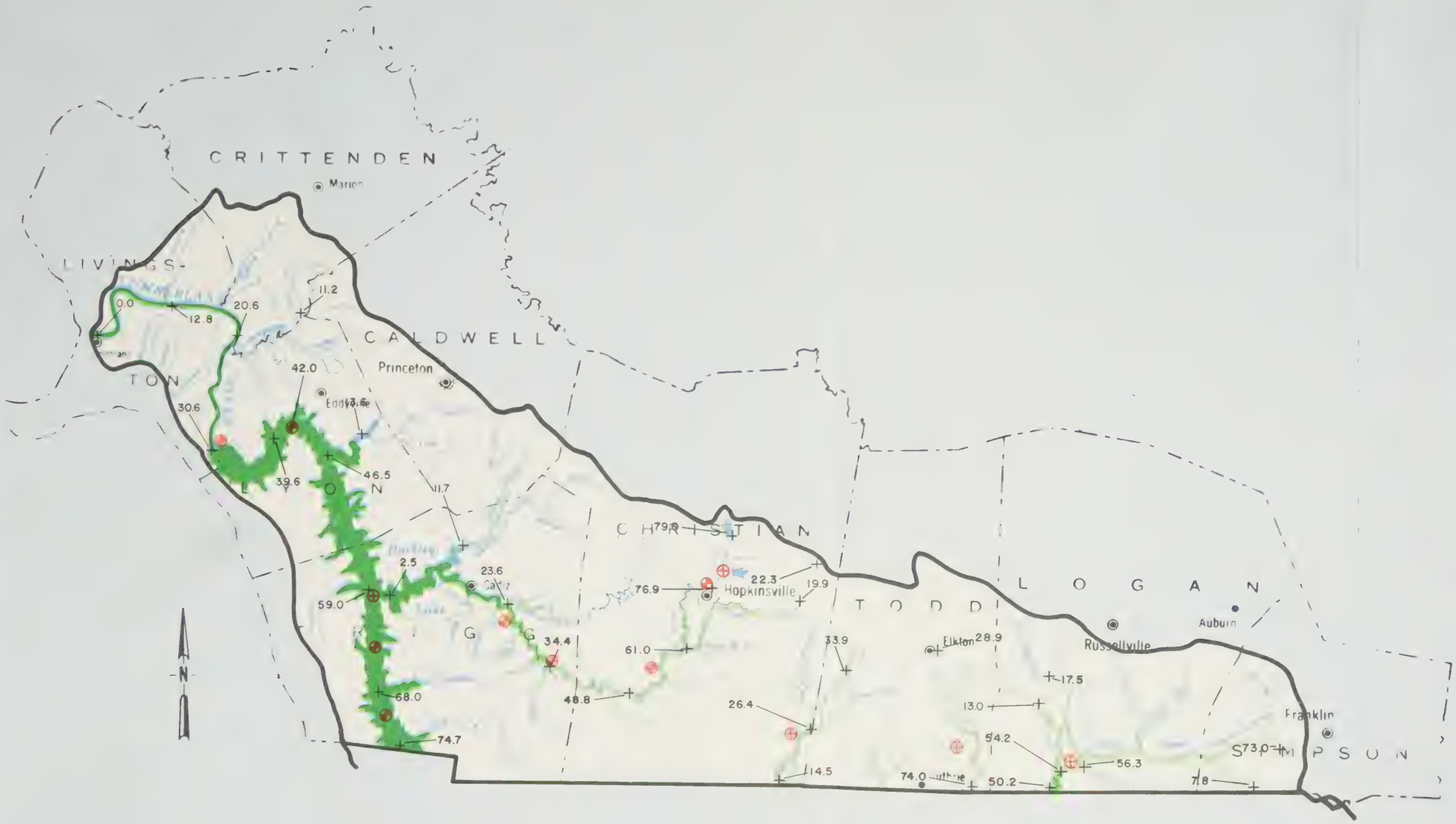

LOWER CUMBERLAND RIVER BASIN

EXHIBIT 3.4m

STEAM FLOW CHARACTERISTICS

LEGEND

LOW FLOW BOUNDARIES (APPROXIMATE)

- 0.10-1 (CFS)
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- GREATER THEN 10 CFS
- PRIMARY MONITORING STATION
- SECONDARY

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GRAPHIC SCALE IN MILES

Base Data: U.S. Geological Survey

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POPULATION, PRESENT AND FUTURE

Over half (54%) the 1975 estimated population of the LCRB is located in the Christian County portion of the basin, primarily in and around the city of Hopkinsville. By 1995, it is projected that the Hopkinsville area will have increased its share to 58% of the basin population. (See Exh. 3.6t)

The other three growth areas in the basin are described by the "1973 Pennyrile A.D.D. Water and Sewer Plan" as:

Lake Barkley Shoreline - to the north and east, including Grand River, Kuttawa, Eddyville, and Cadiz.

Princeton - in Caldwell County, especially in the vicinity of Interstate 24.

Oak Grove Area - in the southeastern part of Christian County, especially in the vicinity of the I-24 and U.S. 41-A intersection.

The A.D.D. study notes that other areas throughout the basin will experience growth fluctuations, but such will be negligible in contrast to the expected expansion in the four major growth, or impact, areas.

1970-1995 Population Growth

In the twenty-five years between 1970 and 1995, it is projected that population changes of the following nature will occur (as shown by Exhibit 3.5t):

...The nine-county area will increase by 56,437 people, with over 70% projected to locate within the LCRB portion of the counties.

...Within the LCRB, the 1970-1995 projected growth is distributed as follows:

..Christian Co. LCRB...71%, or 27,896
..Caldwell Co. LCRB....11%, or 4,344
..Logan County LCRB.... 7%, or 2,834
..Lyon County LCRB..... 4%, or 1,538
..Simpson County LCRB.. 3%, or 969
..Livingston Co. LCRB.. 2%, or 665
..Trigg County LCRB.... 2%, or 630
..Todd County LCRB..... 1%, or 310
..Crittenden Co. LCRB.. 1%, or 193

Procedure for Population Projections

The population figures in Exhibit 3.6t are extracted from the more detailed data in Appendix A-2. County population projections were taken, or interpolated, from the 1972 E.P.A. Region IV "Historical Trends and Population Projections". Urban population projections were partially derived by using the urban percentage projections of the 1972 K.P.D.O. "Kentucky Population Projections". County totals were disaggregated to river basin and segment basin by county, then aggregated to achieve complete segment basins.

Exhibit 3.6t - Population Projections for the Lower Cumberland River Basin

Area of Coverage	At-year population				Between-year number and per cent change					
					1970-'75		1975-'80		1980-'95	
	1970	1975	1980	1995	No.	%	No.	%	No.	%
NINE COUNTY TOTAL	145,344	153,242	161,143	201,781	7,898	5.4	7,901	5.2	40,638	25.2
..Outside LCRB.....	53,586	55,347	57,921	70,644	1,761	3.3	2,574	4.7	12,723	22.0
..Inside LCRB.....	91,758	97,895	103,222	131,137	6,137	6.7	5,327	5.4	27,915	27.0
..Urban.....	41,175	46,175	49,627	67,084	5,000	12.1	3,452	7.5	17,457	35.2
..Rural.....	50,583	51,720	53,595	64,053	1,137	2.3	1,875	3.6	10,458	19.5
..Farm.....	18,551	19,117	19,820	23,652	566	3.1	703	3.7	3,832	19.3
..Non-Farm.....	32,032	32,603	33,775	40,401	571	1.8	1,172	3.6	6,626	19.6
LIVINGSTON CO. TOTAL..	7,596	7,848	8,100	9,300	252	3.3	252	3.2	1,200	14.8
..Outside LCRB.....	4,634	4,787	4,941	5,673	153	3.3	154	3.2	732	14.8
..Inside LCRB.....	2,962	3,061	3,159	3,627	99	3.3	98	3.2	468	14.8
..Urban.....	-	-	-	-	0	0.0	0	0.0	0	0.0
..Rural.....	2,962	3,061	3,159	3,627	99	3.3	98	3.2	468	0.0
..Farm.....	2,281	2,357	2,432	2,793	76	3.3	75	3.2	361	14.8
..Non-Farm.....	681	704	727	834	23	3.4	23	3.3	107	14.7
CRITTENDEN CO. TOTAL..	8,493	8,796	9,100	10,600	303	3.6	304	3.5	1,500	16.5
..Outside LCRB.....	7,231	7,509	7,790	9,146	277	3.8	281	3.7	1,356	17.4
..Inside LCRB.....	1,261	1,287	1,310	1,454	26	2.1	23	1.8	144	11.0
..Urban.....	-	-	-	-	0	0.0	0	0.0	0	0.0
..Rural.....	1,261	1,287	1,310	1,454	26	2.1	23	1.8	144	11.0
..Farm.....	379	386	393	436	7	1.9	7	1.8	43	10.9
..Non-Farm.....	882	901	917	1,018	19	2.2	16	1.8	101	11.0

(continuation) Exhibit 3.6t - Population Projections For The Lower Cumberland River Basin

Area of Coverage	At-Year Population				Between-Year Number and Per Cent Change					
					1970-'75		1975-'80		1980-'95	
	1970	1975	1980	1995	No.	%	No.	%	No.	%
LYON COUNTY TOTAL.....	5,562	5,781	6,000	7,100	219	3.9	219	3.8	1,100	18.3
..Outside LCRB.....	0	0	0	0	0	0.0	0	0.0	0	0.0
..Inside LCRB.....	5,562	5,781	6,000	7,100	219	3.9	219	3.8	1,100	18.3
..Urban.....	-	-	-	-	0	0.0	0	0.0	0	0.0
..Rural.....	5,562	5,781	6,000	7,100	219	3.9	219	3.8	1,100	18.3
..Farm.....	1,446	1,503	1,560	1,846	57	3.9	57	3.8	286	18.3
..Non-Farm.....	4,116	4,278	4,440	5,254	162	3.9	162	3.8	814	18.3
CALDWELL CO. TOTAL....	13,179	13,989	14,800	18,631	810	6.2	811	5.8	3,831	25.9
..Outside LCRB.....	4,486	4,655	4,802	5,594	169	3.8	147	3.2	792	16.5
..Inside LCRB.....	8,693	9,334	9,998	13,037	641	7.4	664	7.1	3,039	30.4
..Urban.....	5,663	6,220	6,820	9,467	557	9.8	600	9.7	2,647	38.8
..Rural.....	3,030	3,114	3,178	3,570	84	2.8	64	2.1	392	12.3
..Farm.....	1,000	1,028	1,049	1,178	28	2.8	21	2.0	129	12.3
..Non-Farm.....	2,030	2,086	2,129	2,392	56	2.8	43	2.1	263	12.4
TRIGG COUNTY TOTAL....	8,620	8,620	8,620	9,250	0	0.0	0	0.0	630	7.3
..Outside LCRB.....	0	0	0	0	0	0.0	0	0.0	0	0.0
..Inside LCRB.....	8,620	8,620	8,620	9,250	0	0.0	0	0.0	630	7.3
..Urban.....	-	-	-	-	0	0.0	0	0.0	0	0.0
..Rural.....	8,620	8,620	8,620	9,250	0	0.0	0	0.0	630	7.3
..Farm.....	2,758	2,758	2,758	2,960	0	0.0	0	0.0	202	7.3
..Non-Farm.....	5,862	5,862	5,862	6,290	0	0.0	0	0.0	428	7.3
CHRISTIAN CO. TOTAL...	56,224	60,562	64,900	87,450	4,338	7.7	4,338	7.2	22,550	34.7
..Outside LCRB.....	7,689	7,631	8,177	11,019	-58	-.8	546	7.2	2,842	34.8
..Inside LCRB.....	48,535	52,931	56,723	76,431	4,396	9.1	3,792	7.2	19,708	34.7
..Urban.....	34,866	39,365	42,185	56,843	4,499	12.9	2,820	7.2	14,658	34.8
..Rural.....	13,669	13,566	14,538	19,588	-103	-.8	972	7.2	5,050	34.7
..Farm.....	4,101	4,070	4,361	5,876	-31	-.8	291	7.2	1,515	34.7
..Non-Farm.....	9,568	9,496	10,177	13,712	-72	-.8	681	7.2	3,535	34.7
TODD COUNTY TOTAL.....	10,823	10,823	10,823	11,300	0	0.0	0	0.0	477	4.4
..Outside LCRB.....	3,788	3,788	3,788	3,955	0	0.0	0	0.0	167	4.4
..Inside LCRB.....	7,035	7,035	7,035	7,345	0	0.0	0	0.0	310	4.4
..Urban.....	-	-	-	-	0	0.0	0	0.0	0	0.0
..Rural.....	7,035	7,035	7,035	7,345	0	0.0	0	0.0	310	4.4
..Farm.....	2,322	2,322	2,322	2,424	0	0.0	0	0.0	102	4.4
..Non-Farm.....	4,713	4,713	4,713	4,921	0	0.0	0	0.0	208	4.4
LOGAN CO. TOTAL.....	21,793	23,046	24,300	30,250	1,253	5.8	1,254	5.4	5,950	24.5
..Outside LCRB.....	14,705	15,487	16,330	20,328	782	5.3	843	5.4	3,998	24.5
..Inside LCRB.....	7,088	7,559	7,970	9,922	471	6.6	411	5.4	1,952	24.5
..Urban.....	646	590	622	774	-56	-8.7	32	5.4	152	24.4
..Rural.....	6,442	6,969	7,348	9,148	527	8.2	379	5.4	1,800	24.5
..Farm.....	2,963	3,206	3,380	4,208	243	8.2	174	5.4	828	24.5
..Non-Farm.....	3,479	3,763	3,968	4,940	284	8.2	205	5.5	972	24.5
SIMPSON CO. TOTAL.....	13,054	13,777	14,500	17,900	723	5.5	723	5.3	3,400	23.5
..Outside LCRB.....	11,052	11,490	12,093	14,929	438	4.0	603	5.3	2,836	23.5
..Inside LCRB.....	2,002	2,287	2,407	2,971	285	14.2	120	5.3	564	23.4
..Urban.....	-	-	-	-	0	0.0	0	0.0	0	0.0
..Rural.....	2,002	2,287	2,407	2,971	285	14.2	120	5.3	564	23.4
..Farm.....	1,301	1,487	1,565	1,931	186	14.3	78	5.2	366	23.4
..Non-Farm.....	701	800	842	1,040	99	14.1	42	5.3	198	23.5

HOUSING UNITS, PRESENT AND FUTURE

The Christian County portion of the LCRB, primarily in the Hopkinsville area, accounted for 48% of the 1970 housing units within the entire basin. By 1995, the projections show this increasing to 53% of the LCRB housing units total.

The majority of the remaining housing growth in the LCRB is projected to occur in the other three "growth areas" of the Lake Barkley Shoreline (to the east and north), Princeton in Caldwell County, and The Oak Grove area in Christian County.

1970-1995 Housing Units Growth

From 1970 to 1995, it is projected that housing unit changes of the following nature should occur (as shown by Exhibit 3.7t):

..The nine county total should increase by 20,248 units, with 13,354 (or 63%) of the increase going into the LCRB area.

..Within the LCRB, the 1970-95 projected growth of 13,354 housing units is distributed as follows:

...Christian Co. LCRB...63%, or 8,459
...Caldwell Co. LCRB....13%, or 1,678
...Logan County LCRB.... 8%, or 1,091
...Lyon County LCRB..... 6%, or 757
...Trigg County LCRB.... 3%, or 370
...Simpson Co. LCRB..... 3%, or 344
...Livingston Co. LCRB.. 2%, or 326
...Todd County LCRB..... 1%, or 175
...Crittenden Co. LCRB.. 1%, or 144

These housing unit projections are extracted from the more detailed figures of Appendix A-3, which are based on projections of population by EPA Region IV, and persons/housing unit by the University of Louisville.

Exhibit 3.7t: Housing Unit Projections for the Lower Cumberland River Basin

Area of Coverage	At-Year Housing Units				Between-Year Number and Per Cent Change					
					1970-'75		1975-'80		1980-'95	
	1970	1975	1980	1995	No.	%	No.	%	No.	%
NINE COUNTY TOTAL.....	44,156	47,720	51,772	64,404	3,564	8.1	4,052	8.5	12,632	24.4
..Outside LCRB.....	17,289	18,343	19,798	24,183	1,054	6.1	1,455	8.0	4,385	22.1
..Inside LCRB.....	26,867	29,377	31,974	40,221	2,510	9.3	2,597	8.8	8,247	25.8
LIVINGSTON CO. TOTAL..	2,642	2,832	3,051	3,503	190	7.2	219	7.7	452	14.8
..Outside LCRB.....	1,612	1,728	1,861	2,137	116	7.2	133	7.7	276	14.8
..Inside LCRB.....	1,030	1,105	1,190	1,356	75	7.3	85	7.7	176	14.8
CRITTENDEN CO. TOTAL..	3,021	3,259	3,534	4,116	238	7.9	275	8.4	582	16.5
..Outside LCRB.....	2,572	2,782	3,025	3,523	210	8.2	243	8.7	498	16.5
..Inside LCRB.....	449	477	509	593	28	6.2	32	6.7	84	16.5
LYON CO. TOTAL.....	1,645	1,819	2,030	2,402	174	10.6	211	11.6	372	18.3
..Outside LCRB.....	0	0	0	0	0	0.0	0	0.0	0	0.0
..Inside LCRB.....	1,645	1,819	2,030	2,402	174	10.6	211	11.6	372	18.3
CLADWELL CO. TOTAL....	4,552	5,001	5,506	6,931	449	9.9	505	10.1	1,425	25.9
..Outside LCRB.....	1,550	1,664	1,786	2,248	114	7.4	122	7.3	462	25.8
..Inside LCRB.....	3,003	3,337	3,719	4,681	334	11.1	382	11.4	962	25.8
TRIGG CO. TOTAL.....	2,710	2,783	2,870	3,080	73	2.7	87	3.1	210	7.3
..Outside LCRB.....	0	0	0	0	0	0.0	0	0.0	0	0.0
..Inside LCRB.....	2,710	2,783	2,870	3,080	73	2.7	87	3.1	210	7.3
CHRISTIAN CO. TOTAL...	14,858	16,399	18,074	24,353	1,541	10.4	1,675	10.2	6,279	35.0
..Outside LCRB.....	2,032	2,066	2,277	3,068	34	2.0	211	10.2	791	35.0
..Inside LCRB.....	12,826	14,333	15,797	21,285	1,507	12.0	1,464	10.0	5,488	35.0
TODD COUNTY TOTAL.....	3,492	3,494	3,603	3,761	2	0.1	109	3.1	158	4.4
..Outside LCRB.....	1,222	1,223	1,261	1,316	1	0.1	38	3.1	55	4.4
..Inside LCRB.....	2,270	2,271	342	2,445	1	0.0	71	3.1	103	4.4
LOGAN COUNTY TOTAL....	7,048	7,640	8,288	10,317	592	8.4	648	8.5	2,029	24.5
..Outside LCRB.....	4,756	5,134	5,570	6,934	378	8.0	436	8.0	1,364	24.5
..Inside LCRB.....	2,292	2,506	2,718	3,383	214	9.0	212	8.0	665	24.5
SIMPSON CO. TOTAL.....	4,188	4,492	4,816	5,945	304	7.0	324	7.0	1,129	23.4
..Outside LCRB.....	3,546	3,746	4,016	4,958	200	6.0	270	7.0	942	23.5
..Inside LCRB.....	642	746	799	986	104	16.0	53	7.0	187	23.0

EMPLOYMENT, PRESENT AND FUTURE

In 1970, about 60% of the employment in the Lower Cumberland River Basin (LCRB) was located in Christian County, primarily in the Hopkinsville area. By 1995, it is projected that the Hopkinsville area will have increased its share to about 65% of the total LCRB employment (Exh. 3.8t).

The majority of the remaining employment, and expected growth, is located in the other three LCRB "growth" areas previously discussed in the population section: north and east of the Lake Barkley Shoreline in Lyon and Trigg Counties, Princeton in Caldwell County, and the Oak Grove area in Christian County.

1970-1995 Employment Growth

Between 1970 and 1995, it is projected that employment changes of the following nature will occur (as shown by Exhibit 3.8t):

...The nine county total will increase by almost 40,000 jobs, with over 60% of the increase going into the LCRB area.

...Within the LCRB, the 1970-95 projected job growth of 24,716 is distributed as follows:

...Christian Co. LCRB...68%, or 16,877
...Caldwell Co. LCRB....17%, or 4,242
...Todd Co. LCRB..... 6%, or 1,487
...Trigg Co. LCRB..... 6%, or 1,443
...Lyon Co. LCRB..... 3%, or 667
...Job growth in the other four counties is projected to occur outside the LCRB.

These employment figures are extracted from the more detailed tables of Appendices A-4 and A-5.

Exhibit 3.8t: Employment Projections for the Lower Cumberland River Basin

Area of Coverage	At-year employment				Between-year number and per cent change					
	1970	1975	1980	1995	1970-'75		1975-'80		1980-'95	
					No.	%	No.	%	No.	%
NINE COUNTY TOTAL.....	33,434	42,821	55,358	73,216	9,387	28.07	12,537	29.27	17,858	32.25
..Out of Basin.....	13,277	17,698	22,174	28,343	4,421	33.29	4,476	25.29	6,169	27.82
..In LCRB.....	20,157	25,123	33,184	44,873	4,966	24.63	8,061	32.08	11,689	35.27
LIVINGSTON COUNTY.....	1,046	1,215	1,418	1,798	169	16.15	203	16.71	380	26.80
..Out of Basin.....	1,046	1,215	1,418	1,798	169	16.15	203	16.71	380	26.80
..In LCRB.....	0	0	0	0	0	0.00	0	0.00	0	0.00
CRITTENDEN COUNTY.....	1,618	2,018	2,443	3,090	400	24.72	425	21.06	647	26.48
..Out of Basin.....	1,618	2,018	2,443	3,090	400	24.72	425	21.06	647	26.48
..In LCRB.....	0	0	0	0	0	0.00	0	0.00	0	0.00
LYON COUNTY.....	692	864	1,049	1,359	172	24.85	185	21.41	310	29.55
..Out of Basin.....	0	0	0	0	0	0.00	0	0.00	0	0.00
..In LCRB.....	692	864	1,049	1,359	172	24.85	185	21.41	310	29.55
CALDWELL COUNTY.....	3,948	5,119	6,420	8,190	1,171	29.66	1,301	25.42	1,770	27.57
..Out of Basin.....	0	0	0	0	0	0.00	0	0.00	0	0.00
..In LCRB.....	3,948	5,119	6,420	8,190	1,171	29.66	1,301	25.42	1,770	27.57
TRIGG COUNTY.....	1,603	1,970	2,409	3,046	367	22.89	439	22.28	637	26.44
..Out of Basin.....	0	0	0	0	0	0.00	0	0.00	0	0.00
..In LCRB.....	1,603	1,970	2,409	3,046	367	22.89	439	22.28	637	26.44
CHRISTIAN COUNTY.....	12,074	14,904	20,610	28,951	2,830	23.42	5,706	38.29	8,341	40.47
..Out of Basin.....	0	0	0	0	0	0.00	0	0.00	0	0.00
..In LCRB.....	12,074	14,904	20,610	28,951	2,830	23.42	5,706	38.29	8,341	40.47
TODD COUNTY.....	1,840	2,266	2,696	3,327	426	23.15	430	18.98	631	23.41
..Out of Basin.....	0	0	0	0	0	0.00	0	0.00	0	0.00
..In LCRB.....	1,840	2,266	2,696	3,327	426	23.15	430	18.98	631	23.41
LOGAN COUNTY.....	5,996	8,174	10,347	13,230	2,178	36.32	2,173	26.58	2,883	27.86
..Out of Basin.....	5,996	8,174	10,347	13,230	2,178	36.32	2,173	26.58	2,883	27.86
..In LCRB.....	0	0	0	0	0	0.00	0	0.00	0	0.00
SIMPSON COUNTY.....	4,617	6,291	7,966	10,225	1,674	36.25	1,675	26.63	2,259	28.36
..Out of Basin.....	4,617	6,291	7,966	10,225	1,674	36.25	1,675	26.63	2,259	28.36
..In LCRB.....	0	0	0	0	0	0.00	0	0.00	0	0.00

LAND USE, PRESENT AND FUTURE

The present and future use that man makes of the land determines, to a large extent, the character of the wastewater treatment load. For this study, it was decided that the land use inventory and projections should include two major categories: urban and rural. Rural land use would be subdivided into agriculture, silviculture, mining, and construction. Urban land use was not to be further subdivided, however, and only the total urban land would be measured.

The necessary land use measurements were to be taken from "water and sewer plans" completed in 1973 and 1974 for the Kentucky Area Development Districts (ADD's). Unfortunately, these plans for the LCRB area did not include the necessary land use data, and other sources had to be found.

Rural Land Use

For rural land use, the most appropriate available source was the Soil Conservation Service, and land use maps they had prepared for each county. Since no measurement data was included, each county map was planimetered to acquire square miles of land use for agriculture, silviculture, and mining. Construction land use was assumed to be the land undergoing, from time to time, transformation from agricultural (or other rural category) to urban use. In projecting land use, it was assumed that the primary change would involve a loss of agricultural land as a gain occurred in urban-related land use. Exhibit 3.9t provides a tabular display of the land uses (extracted from Appendix A-6), while 3.11m provides a graphic illustration. Exhibit 3.10m shows changes in "urban-related" uses, and 3.12m locates existing mining-related land uses.

As shown by Exhibit 3.9t, the only change projected in rural land use was a decrease of 9.64 square miles between 1970-1995 for agriculture--for use by new urban-type development.

Urban-Related Land Use

When measurement difficulties made it impractical to use the Soil Conservation maps to secure urban land use, it was decided that the following procedure would be used:

- ....1970 urban population would be divided by 5.56 persons per acre (or 3,560/sq.mile) to secure land use in urban areas. The persons per acre figure was the average for a couple of areas that could be measured (excluding vacant urban) and also was the average projected for the 17 counties in the Bluegrass A.D.D. "Water and Sewer Plan".
- ....1970 non-farm population was divided by the same figures to secure "urban-type" development located within rural areas.
- ....Both population figures were added together to secure an "urban-type population", and the resulting "urban-related" land use figures are shown by Exhibit 3.9t.

The largest LCRB urbanized area is around Hopkinsville, with the next largest around Princeton in Caldwell County. As shown by Exh. 3.10m, a similar urban pattern is projected between 1970-1995, as 9.64 square miles of new urban land is developed withing the LCRB.

Exhibit 3.10m: Urban-Related Land Use Projections, in Square Miles, for LCRB Portion of Counties

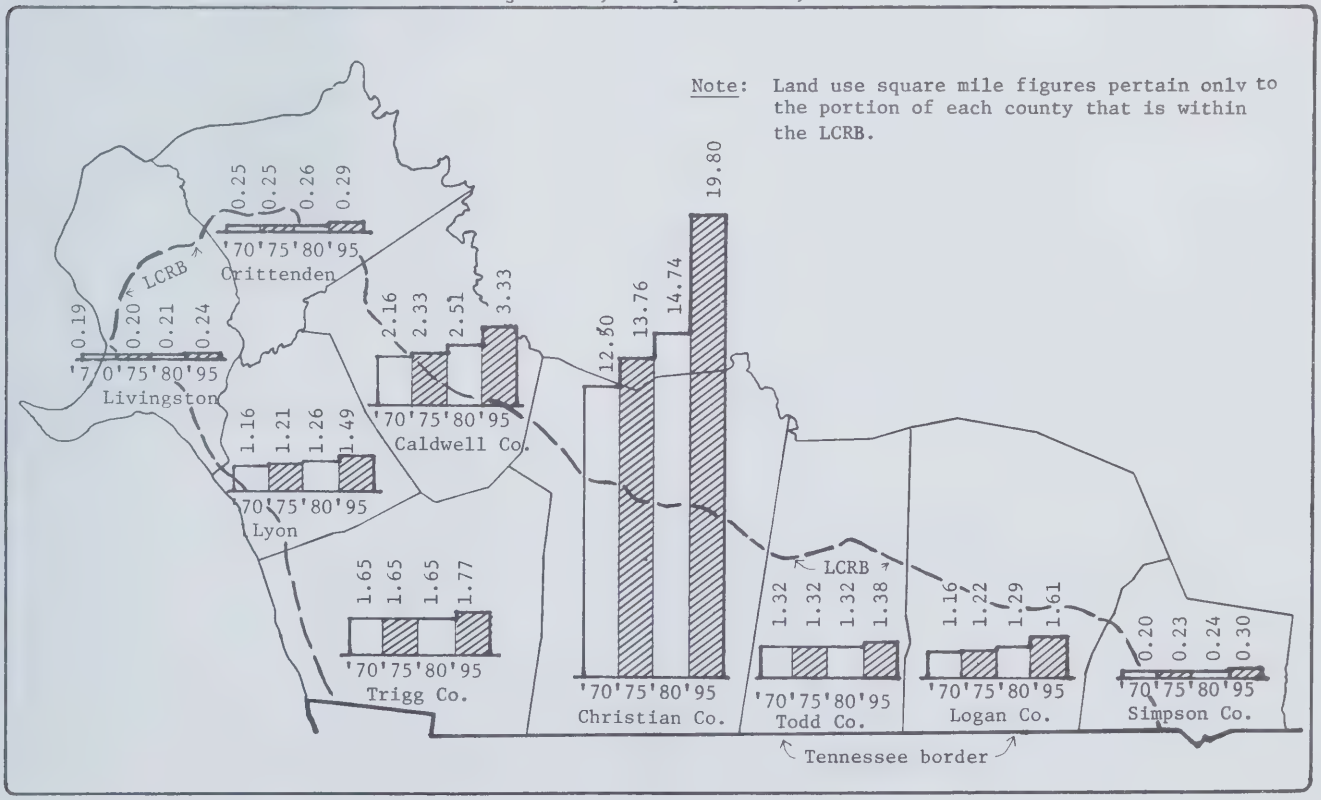


Exhibit 3.9t: Land Use Projections for the Lower Cumberland River Basin

Area of Coverage	"At-Year" Land Use				"Between-Year" Number and Percent Change					
					1970-'75		1975-'80		1980-'95	
	1970 Sq.Mi.	1975 Sq.Mi.	1980 Sq.Mi.	1995 Sq.Mi.	No.	%	No.	%	No.	%
NINE-COUNTY TOTAL...	3,710.00	3,710.00	3,710.00	3,710.00	0.00	0.00	0.00	0.00	0.00	0.00
..Out of Basin.....	1,653.00	1,653.00	1,653.00	1,653.00	0.00	0.00	0.00	0.00	0.00	0.00
..Inside LCRB.....	2,057.00	2,057.00	2,057.00	2,057.00	0.00	0.00	0.00	0.00	0.00	0.00
..Rural.....	2,036.44	2,034.87	2,033.57	2,026.80	-1.57	-0.08	-1.30	-0.06	-6.77	-0.33
..Agriculture...	1,856.56	1,854.99	1,853.69	1,846.92	-1.57	-0.09	-1.30	-0.07	-6.77	-0.37
..Silviculture..	178.00	178.00	178.00	178.00	0.00	0.00	0.00	0.00	0.00	0.00
..Mining.....	1.88	1.88	1.88	1.88	0.00	0.00	0.00	0.00	0.00	0.00
..Construction..	-	-	-	-	(1.57)	0.00	(1.30)	0.00	(6.77)	0.00
..Urban-Related...	20.56	22.13	23.43	30.20	1.57	7.64	1.30	5.87	6.77	28.90
(Urban-Type Pop)	(73,207)	(78,778)	(83,402)	(107,485)	(5,571)	(7.56)	(4,624)	(5.87)	(24,083)	28.88
(Person/Sq.Mi.).	(3,560)	(3,560)	(3,560)	(3,560)	0.00	0.00	0.00	0.00	0.00	0.00
LIVINGSTON COUNTY...	342.00	342.00	342.00	342.00	0.00	0.00	0.00	0.00	0.00	0.00
..Out of Basin.....	207.50	207.50	207.50	207.50	0.00	0.00	0.00	0.00	0.00	0.00
..Inside LCRB.....	134.50	134.50	134.50	134.50	0.00	0.00	0.00	0.00	0.00	0.00
..Rural.....	134.31	134.30	134.29	134.26	-.01	-.01	-.01	-.01	-.03	-.02
..Agriculture...	127.31	127.30	127.29	127.26	-.01	-.01	-.01	-.01	-.03	-.02
..Silviculture..	6.40	6.40	6.40	6.40	0.00	0.00	0.00	0.00	0.00	0.00
..Mining.....	0.58	0.58	0.58	0.58	0.00	0.00	0.00	0.00	0.00	0.00
..Construction..	-	-	-	-	(.01)	0.00	(.01)	0.00	(.03)	0.00
..Urban-Related...	0.19	0.20	0.21	0.24	0.01	5.30	0.01	5.00	0.03	14.30
(Urban-Type Pop)	(681)	(704)	(727)	(834)	(23)	(3.40)	(23)	(3.30)	(107)	(14.70)
(Person/Sq.Mi.).	(3,560)	(3,560)	(3,560)	(3,560)	0.00	0.00	0.00	0.00	0.00	0.00
CRITTENDEN COUNTY...	376.00	376.00	376.00	376.00	0.00	0.00	0.00	0.00	0.00	0.00
..Out of Basin.....	290.20	290.20	290.20	290.20	0.00	0.00	0.00	0.00	0.00	0.00
..Inside LCRB.....	85.80	85.80	85.80	85.80	0.00	0.00	0.00	0.00	0.00	0.00
..Rural.....	85.55	85.55	85.54	85.51	0.00	0.00	-.01	-.01	-.03	-0.35
..Agriculture...	85.55	85.55	85.54	85.51	0.00	0.00	-.01	-.01	-.03	-0.35
..Silviculture..	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
..Mining.....	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
..Construction..	-	-	-	-	(0.00)	0.00	(.01)	0.00	(.03)	0.00
..Urban-Related...	0.25	0.25	0.26	0.29	0.00	0.00	0.01	3.70	0.03	11.00
(Urban-Type Pop)	(882)	(901)	(917)	(1,018)	(19)	2.20	(16)	1.80	(101)	11.00
(Person/Sq.Mi.).	(3,560)	(3,560)	(3,560)	(3,560)	0.00	0.00	0.00	0.00	0.00	0.00
LYON COUNTY.....	263.00	263.00	263.00	263.00	0.00	0.00	0.00	0.00	0.00	0.00
..Out of Basin.....	34.00	34.00	34.00	34.00	0.00	0.00	0.00	0.00	0.00	0.00
..Inside LCRB.....	229.00	229.00	229.00	229.00	0.00	0.00	0.00	0.00	0.00	0.00
..Rural.....	227.84	227.79	227.74	227.51	-.05	-.02	-.05	-.02	-.23	-.10
..Agriculture...	187.14	187.09	187.04	186.81	-.05	-.03	-.05	-.03	-.23	-.12
..Silviculture..	40.70	40.70	40.70	40.70	0.00	0.00	0.00	0.00	0.00	0.00
..Mining.....	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
..Construction..	-	-	-	-	(.05)	0.00	(.05)	0.00	(.23)	0.00
..Urban-Related...	1.16	1.21	1.26	1.49	0.05	4.30	0.05	4.10	0.23	23.10
(Urban-Type Pop)	(4,116)	(4,278)	(4,440)	(5,254)	(162)	3.90	(162)	3.80	(814)	18.30
(Person/Sq.Mi.).	(3,560)	(3,560)	(3,560)	(3,560)	0.00	0.00	0.00	0.00	0.00	0.00
CALDWELL COUNTY.....	357.00	357.00	357.00	357.00	0.00	0.00	0.00	0.00	0.00	0.00
..Out of Basin.....	198.60	198.60	198.60	198.60	0.00	0.00	0.00	0.00	0.00	0.00
..Inside LCRB.....	158.40	158.40	158.40	158.40	0.00	0.00	0.00	0.00	0.00	0.00
..Rural.....	156.24	156.07	155.89	155.07	-.17	-0.10	-.18	-0.10	-.82	-0.53
..Agriculture...	151.91	151.74	151.56	150.74	-.17	-0.10	-.18	-0.10	-.82	-0.53
..Silviculture..	4.18	4.18	4.18	4.18	0.00	0.00	0.00	0.00	0.00	0.00
..Mining.....	0.15	0.15	0.15	0.15	0.00	0.00	0.00	0.00	0.00	0.00
..Construction..	-	-	-	-	(.17)	0.00	(.18)	0.00	(.82)	0.00
..Urban-Related...	2.16	2.33	2.51	3.33	0.17	7.87	0.18	7.73	0.82	32.67
(Urban-Type Pop)	(7,693)	(8,306)	(8,949)	(11,859)	(613)	7.97	(643)	7.75	(2,910)	32.51
(Person/Sq.Mi.).	(3,560)	(3,560)	(3,560)	(3,560)	0.00	0.00	0.00	0.00	0.00	0.00

(continuation) Exhibit 3.9t: Land Use Projections for the Lower Cumberland River Basin

Area of Coverage	"At-Year" Land Use				"Between-Year" Number and Percent Change					
					1970-'75		1975-'80		1980-'95	
	1970 Sq.Mi.	1975 Sq.Mi.	1980 Sq.Mi.	1995 Sq.Mi.	No.	%	No.	%	No.	%
TRIGG COUNTY.....	468.00	468.00	468.00	468.00	0.00	0.00	0.00	0.00	0.00	0.00
..Out of Basin.....	41.00	41.00	41.00	41.00	0.00	0.00	0.00	0.00	0.00	0.00
..Inside LCRB.....	427.00	427.00	427.00	427.00	0.00	0.00	0.00	0.00	0.00	0.00
..Rural.....	425.35	425.35	425.35	425.23	0.00	0.00	0.00	0.00	-.12	-0.03
..Agriculture...	297.85	297.85	297.85	297.73	0.00	0.00	0.00	0.00	-.12	-0.04
..Silviculture..	127.10	127.10	127.10	127.10	0.00	0.00	0.00	0.00	0.00	0.00
..Mining.....	0.40	0.40	0.40	0.40	0.00	0.00	0.00	0.00	0.00	0.00
..Construction..	-	-	-	-	(0.00)	0.00	(0.00)	0.00	(0.12)	0.00
..Urban-Related...	1.65	1.65	1.65	1.77	0.00	0.00	0.00	0.00	(0.12)	7.27
(Urban-Type Pop)	(5,862)	(5,862)	(5,862)	(6,290)	(0)	0.00	(0)	0.00	(428)	7.30
(Person/Sq.Mi.).	(3,560)	(3,560)	(3,560)	(3,560)	0.00	0.00	0.00	0.00	0.00	0.00
CHRISTIAN COUNTY....	726.00	726.00	726.00	726.00	0.00	0.00	0.00	0.00	0.00	0.00
..Out of Basin.....	260.00	260.00	260.00	260.00	0.00	0.00	0.00	0.00	0.00	0.00
..Inside LCRB.....	466.00	466.00	466.00	466.00	0.00	0.00	0.00	0.00	0.00	0.00
..Rural.....	453.50	452.24	451.26	446.20	-1.26	-0.28	-0.98	-0.22	-5.06	-1.12
..Agriculture...	452.91	451.64	450.66	445.60	-1.26	-0.28	-0.98	-0.22	-5.06	-1.12
..Silviculture..	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
..Mining.....	0.60	0.60	0.60	0.60	0.00	0.00	0.00	0.00	0.00	0.00
..Construction..	-	-	-	-	(1.26)	0.00	(0.98)	0.00	(5.06)	0.00
..Urban-related...	12.50	13.76	14.74	19.80	1.26	10.10	0.98	7.12	5.06	34.33
(Urban-Type Pop)	(44,434)	(48,861)	(52,362)	(70,555)	(4,427)	9.96	(3,501)	7.17	(18,193)	34.74
(Person/Sq.Mi.).	(3,560)	(3,560)	(3,560)	(3,560)	0.00	0.00	0.00	0.00	0.00	0.00
TODD COUNTY.....	376.00	376.00	376.00	376.00	0.00	0.00	0.00	0.00	0.00	0.00
..Out of Basin.....	131.40	131.40	131.40	131.40	0.00	0.00	0.00	0.00	0.00	0.00
..Inside LCRB.....	244.60	244.60	244.60	244.60	0.00	0.00	0.00	0.00	0.00	0.00
..Rural.....	243.28	243.28	243.28	243.22	0.00	0.00	0.00	0.00	-0.06	-0.03
..Agriculture...	243.28	243.28	243.28	243.22	0.00	0.00	0.00	0.00	-0.06	-0.03
..Silviculture..	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
..Mining.....	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
..Construction..	-	-	-	-	(0.00)	0.00	(0.00)	0.00	(0.06)	0.00
..Urban-Related...	1.32	1.32	1.32	1.38	0.00	0.00	0.00	0.00	0.06	4.54
(Urban-Type Pop)	(4,713)	(4,713)	(4,713)	(4,921)	(0)	0.00	(0)	0.00	(208)	4.41
(Person/Sq.Mi.).	(3,560)	(3,560)	(3,560)	(3,560)	0.00	0.00	0.00	0.00	0.00	0.00
LOGAN COUNTY.....	563.00	563.00	563.00	563.00	0.00	0.00	0.00	0.00	0.00	0.00
..Out of Basin.....	325.00	325.00	325.00	325.00	0.00	0.00	0.00	0.00	0.00	0.00
..Inside LCRB.....	238.00	238.00	238.00	238.00	0.00	0.00	0.00	0.00	0.00	0.00
..Rural.....	236.84	236.78	236.71	236.39	-0.06	-0.03	-0.07	-0.03	-0.32	-0.14
..Agriculture...	236.69	236.63	236.56	236.24	-0.06	-0.03	-0.07	-0.03	-0.32	-0.14
..Silviculture..	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
..Mining.....	0.15	0.15	0.15	0.15	0.00	0.00	0.00	0.00	0.00	0.00
..Construction..	-	-	-	-	(0.06)	0.00	(0.07)	0.00	(0.32)	0.00
..Urban-Related...	1.16	1.22	1.29	1.61	0.06	6.89	0.07	4.84	0.32	24.81
(Urban-Type Pop)	(4,125)	(4,353)	(4,590)	(5,714)	(228)	5.53	(237)	5.44	(1,124)	24.49
(Person/Sq.Mi.).	(3,560)	(3,560)	(3,560)	(3,560)	0.00	0.00	0.00	0.00	0.00	0.00
SIMPSON COUNTY.....	239.00	239.00	239.00	239.00	0.00	0.00	0.00	0.00	0.00	0.00
..Out of Basin.....	165.30	165.30	165.30	165.30	0.00	0.00	0.00	0.00	0.00	0.00
..Inside LCRB.....	73.70	73.70	73.70	73.70	0.00	0.00	0.00	0.00	0.00	0.00
..Rural.....	73.50	73.47	73.46	73.40	-0.03	-0.04	-0.01	-0.01	-0.06	-0.08
..Agriculture...	73.50	73.47	73.46	73.40	-0.03	-0.04	-0.01	-0.01	-0.06	-0.08
..Silviculture..	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
..Mining.....	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
..Construction..	-	-	-	-	(0.03)	0.00	(0.01)	0.00	(0.06)	0.00
..Urban-Related...	0.20	0.23	0.24	0.30	0.03	15.00	0.01	4.35	0.06	25.00
(Urban-Type Pop)	(701)	(800)	(842)	(1,040)	(99)	14.20	(42)	5.25	(198)	23.52
(Person/Sq.Mi.).	(3,560)	(3.560)	(3,560)	(3,560)	0.00	0.00	0.00	0.00	0.00	0.00

BASIN WASTEWATER CONTROL

The purpose of this section is to discuss in general terms the most common methods of sewage collection, treatment, and disposal for various population densities, industries and agricultural operations in the Lower Cumberland River Basin.

Collection Systems

Conventional sewage collection systems are utilized by the municipalities, industries, and domestic dischargers throughout the Lower Cumberland River Basin. Gravity flow is used for carrying the sewage to the treatment facilities wherever topography allows and conventional pump stations provide the sewage conveyance where gravity flow is impossible or economically infeasible. The municipal collection facilities consist of collector sewers picking up sewage at house laterals with the collection flowing into the interceptors, and the interceptors carrying the waste to the treatment plants.

In general, the eleven municipalitites in the LCRB having centralized treatment facilities provide adequate collection facilities for the majority of residences. In some cases, however, there are no city or county ordinances requiring tap-on of homes to the available sewers. This limits effective control of groundwater pollution due to septic tanks and cesspools.

Domestic and industrial waste collection for the most part consists of one to several collector sewers to carry sewage to the treatment facility.

Treatment Methods

Existing sewage treatment facilities in the LCRB include extended aeration, settling tank-sand filtration, trickling filter, activated sludge, and stabilization ponds.

Extended Aeration

Aeration plants are utilized for small communities, recreational sites, housing developments, and industries. This pattern is exhibited in the L.C.R.B. with the most common type of sewage treatment facility being the extended aeration plant. Current records show 80 individual point discharges having treatment facilities in the LCRB, and 36 of these facilities are extended aeration plants. Information to date shows all of the extended aeration plants to be factory built, "package" type units which require minimum construction effort for installation. The largest extended air plants being utilized are those at Cadiz, Kentucky and Trenton, Kentucky, having respectively treatment capacities of 300,000 and 120,000 gallons per day. When operating properly, these plants should show greater than 90% removal of suspended solids, five day B.O.D. and ammonia-nitrogen with even greater removal possible where plants are operating below design capacity.

Settling Tank-Sand Filtration

The next most common type of sewage treatment utilized in the LCRB is that of settling tank followed by sand filtration. This type of treatment also is used most often for small communities, recreational sites, motels, etc. If properly designed and maintained, and if operated at or below capacity, this type of treatment is capable of removing 75 to 85 percent of suspended solids and five day BOD. Most common failures in this type of facility result from overloading with excess flow, improper and/or infrequent removal of sludge from the surface of the sand filters. Sixteen of the eighteen dischargers in the LCRB having this type of treatment have flow rates less than 5000 gallons per day.

Trickling Filter

The sewage treatment plants having the highest design capacity in the LCRB are trickling filter plants. Three of the four trickling filter plants in the LCRB serve municipalities. They are: Eddyville, with a capacity of 75,000 gpd (gallons per day); Princeton, 900,000 gpd; and Hopkinsville, 3 MGD The fourth trickling filter plant serves Western State Hospital and has a capacity of 300,000 gpd. These plants, if operating properly, should obtain 85 percent removal of suspended solids and five day-BOD.

Activated Sludge

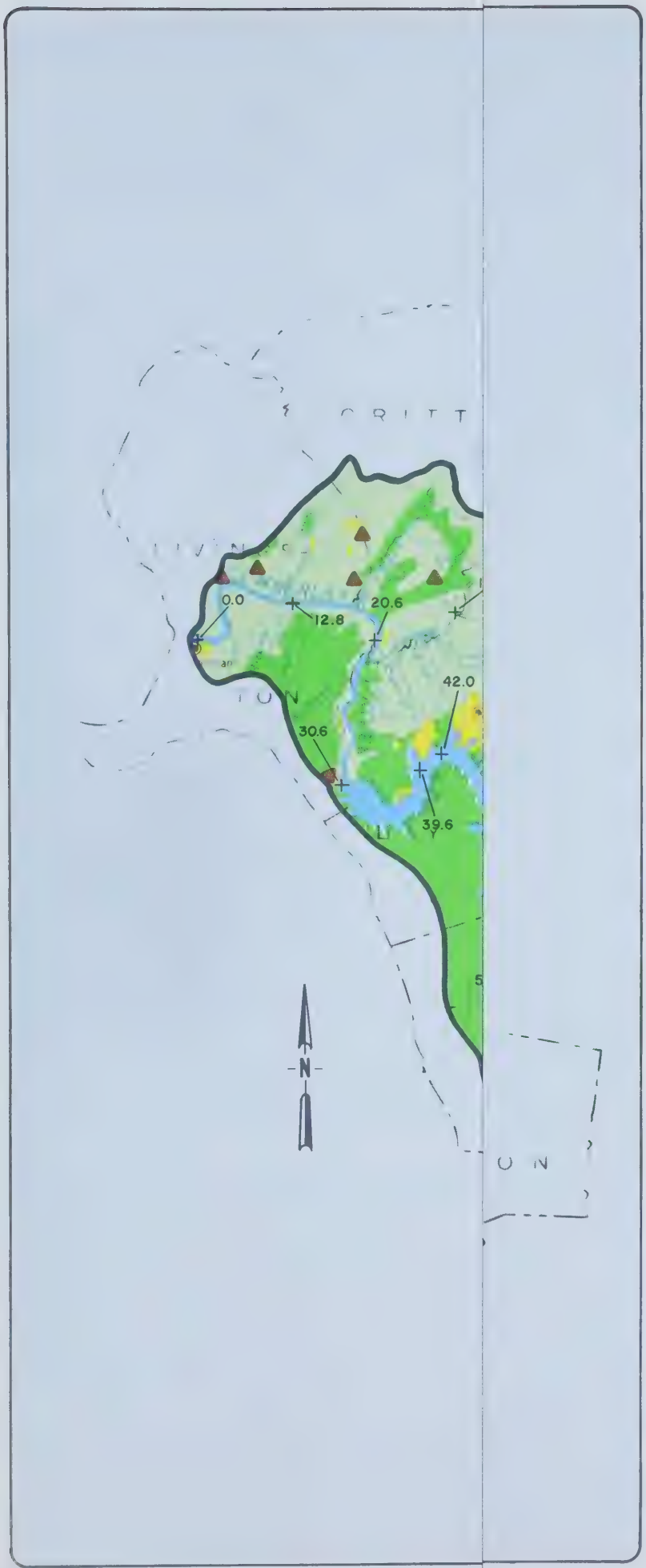
There are two conventional activated sludge sewage treatment plants and two contact stabilization plants (a type of activated sludge treatment) in the LCRB, and they all serve municipalities. The cities served by these plants and the respective plant capacities are: with conventional activated sludge, Kuttawa--350,000 gpd and Elkton--250,000 gpd; with contact stabilization, Adairville--150,000 gpd and Pembroke--70,000 gpd. This activated sludge process of treatment should yield 90 percent removal of suspended solids and 5 day-BOD and 20 percent removal of ammonia nitrogen, when operated properly within design capacity of the facility. This type of treatment has become very popular in recent years especially in the larger cities due to minimal land requirements, construction cost and high waste removal efficiencies.

Stabilization Ponds

Stabilization pond (lagoon) facilities are used at nine of the point discharges in the LCRB, the largest serving Smithland, Kentucky and having a capacity of 70,000 gpd. The other eight lagoon facilities treat waste from hog parlors (feedlots). These lagoons, if operated properly within design capacities, should give 60 percent removal of suspended solids, 80 to 90 percent removal of five day-BOD and 95 percent removal of ammonia-nitrogen.

Disposal Methods

Effluent from the sewage treatment facilities is discharged primarily into tributaries of the main streams draining the LCRB; but, in some cases, is discharged into sinkholes. Sinkhole discharge can pose a severe threat to the groundwater supplies, especially if the effluent is not properly chlorinated or otherwise sterilized. Sludge disposal method varies, although one currently used technique is land application by farmers on pasture land and non-vegetable crops.



LOWER CUMBERLAND RIVER BASIN

EXHIBIT 3.11m

LAND USE

LEGEND

- AGRICULTURE
- SILVICULTURE
- MINING RELATED
- URBAN

5 0 10 20

GRAPHIC SCALE IN MILES

Base Data: U.S. Geological Survey

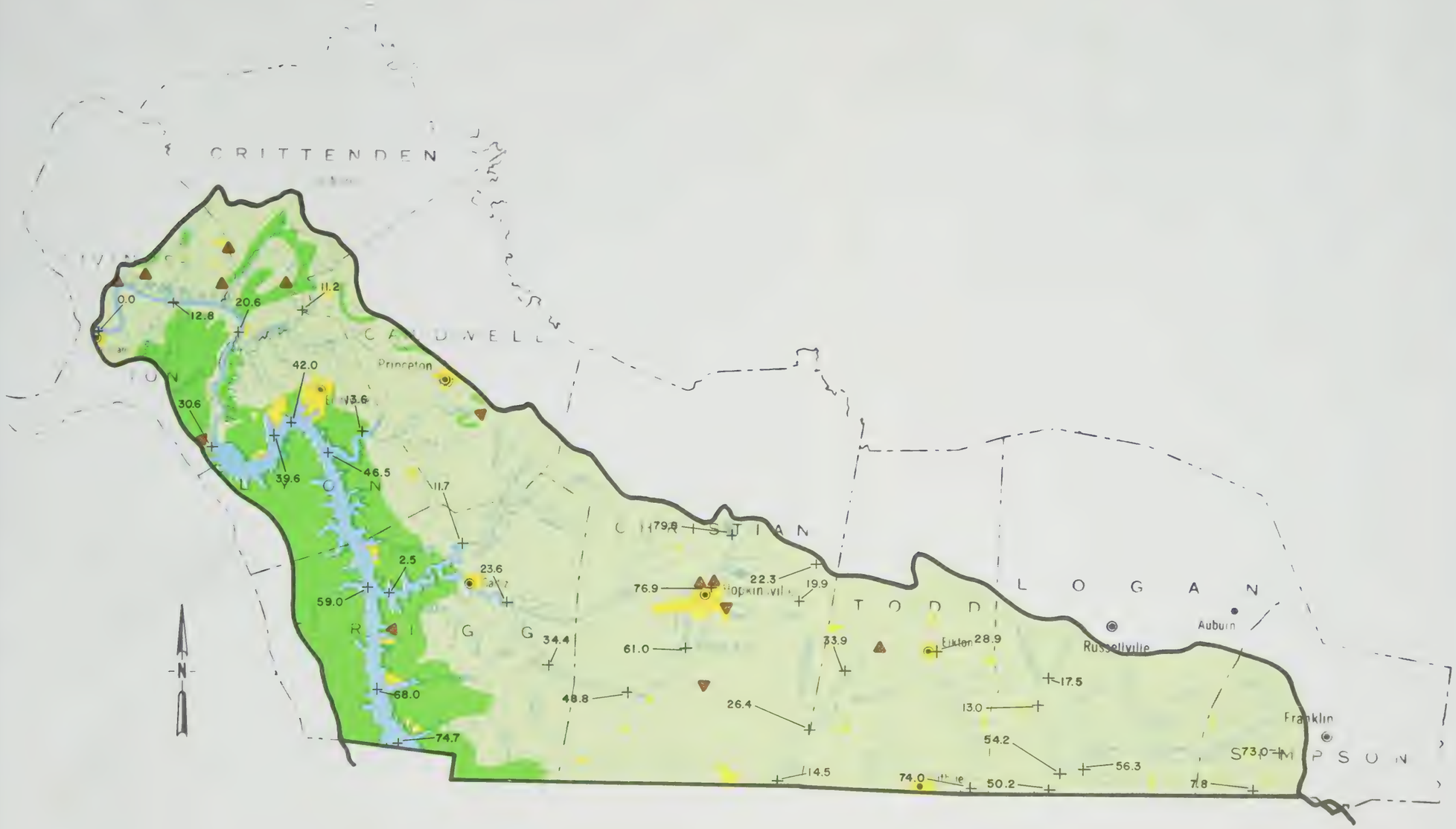
KENTUCKY WATER QUALITY MANAGEMENT PLAN

Prepared for Division of Water Quality

KENTUCKY DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION

G. REYNOLDS WATKINS CONSULTING ENGINEERS, INC.

Lexington, Bowling Green & Louisville, Kentucky



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EXISTING WATER QUALITY AND APPLICABLE STANDARDS

The purpose of this section is to give pertinent background data concerning existing water quality and applicable standards for the streams of the Lower Cumberland River Basin.

Applicable Standards

Water quality standards, for Kentucky are summarized in two documents relating to KRS 224.010, 224.210, and 224.990. These articles, WP-4-1 and WP-6-2 respectively, describe the applicable water quality standards for which we are striving in the preparation of NPDES Permits, 201 Facilities Plans, and 303 River Basin Plans. WP-4-1, Water Quality Standards for Water of the Commonwealth of Kentucky, sets limits on the physical and chemical constituents of Kentucky streams based on their use classification. Kentucky's streams are divided into five use classifications:

1) Public Water supply and food processing
2) Industrial water supply
3) Aquatic life
4) Recreation
5) Agriculture

In locations where a stream might be used for more than one of these classifications, that stream must meet the most stringent of the standards applicable.

Regulation WP-6-2, Use Classification for Waters, Treatment Requirements, and Compliance for Waters of the Commonwealth of Kentucky, discusses the limitations imposed upon individual point source dischargers in order to maintain the standards set by WP-4-1. Copies of WP-4-1 and WP-6-2 follow this paragraph.

WP-4-1

Re: WATER QUALITY STANDARDS FOR WATERS OF THE COMMONWEALTH OF KENTUCKY

Relates to KRS 224.010 to 224.210 and 224.990

Supersedes WP-4

Pursuant to the authority vested in the Water Pollution Control Commission by KRS 224.040, the following regulation is adopted:

Section 1. Prohibitions. No person or group of persons as defined in KRS 224.010 shall cause to be violated any one of the minimum standards in Section 2 or any one of the standards established in Section 3 of this regulation.

Section 2. The following are minimum conditions applicable to all waters of the Commonwealth of Kentucky. All waters of the Commonwealth shall be:

(1) Substantially free from substances attributable to municipal, industrial or other discharges or agricultural practices that will settle to form putrescent sludge deposits;

(2) Free from floating debris, oil, scum and other floating materials attributable to municipal, industrial or other discharges or agricultural practices in amounts sufficient to be unsightly or deleterious;

(3) Free from materials attributable to municipal, industrial or other discharges or agricultural practices producing color, odor or other conditions in such degree as to create a nuisance; and

(4) Free from substances attributable to municipal, industrial or other discharges or agricultural practices in concentrations or combinations which are toxic or harmful to human, animal, plant or aquatic life.

(5) In the standards established by Subsections (1) through (4), every person as defined in KRS 224.010 shall remove from their discharges those substances described in Subsections (1) through (4) to the lowest practicable level attainable under current technology.

Section 3. Stream use classification. In addition to the minimum conditions set forth in Section 2, the following specific stream use classification shall govern where applicable:

(1) Public water supply and food processing industries. The following criteria are applicable to surface water at the point at which water is withdrawn for use for a public water supply or by a food processing industry.

(a) Bacteria: Coliform group not to exceed 5,000 per 100 ml as a monthly arithmetical average value (either MPN or MF count); nor exceed this number in more than 20 percent of the samples examined during any month; nor exceed 20,000 per 100 ml in more than 5 percent of such samples.

(b) Threshold-odor number; After normal treatment to be less than 3.

(c) Dissolved solids: Not to exceed 500 mg/l as a monthly average value, nor exceed 750 mg/l at any time. (Values of specific conductance of 800 and 1,200 micromhos/cm (at 25°C.) may be considered equivalent to dissolved solids concentrations of 500 and 750 mg/l.)

(d) Radioactive substances: Gross beta activity not to exceed 1,000 picocuries per liter, (pCi/l), nor shall activity from dissolved Strontium 90 exceed 10 pCi/l, nor shall activity from dissolved alpha emitters exceed 3 pCi/l.

(e) Chemical constituents: Not to exceed the following specified concentrations at any time:

Constituents	Concentration (mg/l)
Arsenic	0.05
Barium	1.0
Cadmium	0.01
Chromium (Hexavalent)	0.05
Cyanide	0.025
Fluoride	1.0
Lead	0.05
Selenium	0.01
Silver	0.05

(2) Industrial water supply. The following criteria are applicable to water at the point at which water is withdrawn for use, either with or without treatment, for industrial cooling and processing (other than food processing) and shall be applicable only within a mixing zone.

(a) pH: Not less than 5.0 nor greater than 9.0 at any time.

(b) Temperature: Not to exceed 95°F. at any time.

(c) Dissolved solids: Not to exceed 750 mg/l as a monthly average value, nor exceed 1,000 mg/l at any time. (Values of specific conductance of 1,200 and 1,600 micromhos/cm (at 25°C.) may be considered equivalent to dissolved-solids concentrations of 750 and 1,000 mg/l.)

(3) Aquatic life. The following criteria are for evaluation of conditions for the maintenance of well balanced, indigenous fish population. The aquatic use standards shall not apply to areas immediately adjacent to outfalls. Areas immediately adjacent to outfalls shall be as small as possible, be provided for mixing only, and shall not prevent the free passage of fish and drift organisms.

(a) Dissolved oxygen. Concentrations shall average at least 5.0 mg/l per calendar day and shall not be less than 4.0 mg/l at any time or any place outside the mixing zone.

(b) pH: No values below 6.0 nor above 9.0.

(c) Temperature:

(i) Not to exceed 89°F.

(ii) There shall be no abnormal temperature changes that may affect aquatic life unless caused by natural conditions.

(iii) The normal daily and seasonal temperature fluctuations that existed before the addition of heat due to other than natural causes shall be maintained.

(iv) The maximum temperature rise at any time or place above natural temperatures shall not exceed 5°F. in streams. In addition, the water temperature for all streams shall not exceed the maximum limits indicated in the following table:

Stream maximum temperature for each month in °F.

Jan.	50
Feb.	50
March	60
April	70
May	80
June	87
July	89
Aug.	89
Sept.	87
Oct.	78
Nov.	70
Dec.	57

(v) The allowable temperature increase in public water impoundments will be limited to 3°F. in the epilimnion if thermal stratification exists. Public water impoundments include all impounded waters of the Commonwealth which are open to the public and used by the public.

(d) Toxic substances: Not to exceed one-tenth of the 96-hour median tolerance limit of fish; where there are substances that are toxic because of their cumulative characteristics other limiting concentrations may be used in specific cases as presently approved by the Federal Environmental Protection Agency, or as later adopted by the Water Pollution Control Commission.

(e) Put-and-take trout streams: The following criteria are applicable to those waters designated by the Commission as put-and-take trout streams:

(i) Dissolved oxygen: Concentrations shall not be less than 6.0 mg/l at any time or any place. Spawning areas (during the spawning season) shall be protected by a minimum DO concentration of 7.0 mg/l.

(ii) Temperature: Stream temperatures shall not be increased artificially above the natural temperature at any time in cold water trout streams.

(4) Recreation: Unless caused by natural conditions, the following criterion shall apply in waters to be used for recreational purposes, (including but not limited to such water-contact activities as swimming and water skiing).

Bacteria: The total coliform level shall not exceed an average 1,000 per 100 ml. Total coliform shall not exceed this number in 20% of the samples in a month, nor exceed 2400/100 ml on any day. If the level of total coliform is exceeded, then a fecal coliform standard shall be used. There shall be a reduction of fecal coliform to such degree that (i) during the months of May through October fecal coliform density in the discharge does not exceed 200 per 100 ml as a monthly geometric mean (based on not less than ten samples per month), nor exceed 400 per 100 ml in more than ten percent of the samples examined during a month, and (ii) during the months of November through April the density does not exceed 1,000 per 100 ml as a monthly geometric mean (based on not less than ten samples per month), nor exceed 2,000 per 100 ml in more than ten percent of the samples examined during a month.

(5) Agricultural: No criteria in addition to the minimum conditions enumerated in Section 2 are proposed for the evaluation of stream quality at the point at which water is withdrawn for agricultural and stock watering use.

Section 4. Multiple uses. One or more uses established in Section 3 may apply to the same waters. The use criteria shall apply to those waters suitable for the use or uses provided in Section 3. In the event there is a conflict between or among the applicable uses, the more stringent use criteria shall apply.

Section 5. Regulation WP-4 is superseded.

Adopted: July 23, 1971
Filed: July 23, 1971
Effective: Aug. 22, 1971

WP-6-2

Re: USE CLASSIFICATION FOR WATERS, TREATMENT REQUIREMENTS, AND COMPLIANCE FOR WATERS OF THE COMMONWEALTH OF KENTUCKY

Relates to KRS 224

Pursuant to the authority vested in the Department of Natural Resources and Environmental Protection by KRS 224.033 (17), 224.045 and Executive Order 73-1, Relating to Reorganization. January 3, 1973, the

following regulation is adopted:

Section 1. (1) Except as otherwise provided by law, all waters shown on the map "Streams of Kentucky" prepared by the Kentucky Department of Commerce, Frankfort, Kentucky 1973, (Scale 1" = 10 miles) are classified for all uses in accord with WP-4-1, Sections 3 and 4.

(2) All discharges to waters not shown on the map described in (1) of this section shall meet all use classifications set forth in WP-4-1, Sections 3 and 4, at the point where those waters join with waters shown on the map.

Section 2. (1) All persons who discharge through point sources, including but not limited to any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged, shall satisfy the requirements of this section.

(2) All persons who discharge through a point source shall apply the best practicable control technology considering such factors as the total cost of the application of such technology in relation to the effluent reduction benefits to be achieved from such application, the age of the equipment and facilities involved, the process employed, the engineering aspects of the application of various types of control techniques, process changes, non-water quality environmental impact and such other factors as the Department considers appropriate to treatment facilities not later than July 1, 1977.

(3) All persons who discharge through a point source shall apply the best available technology economically achievable by July 1, 1983. In determining what is the best available technology economically achievable, the factors in (2), of this section, shall be considered, and in addition, any control measures and practices available to eliminate the discharge of pollutants, taking into account the cost of eliminating the discharge of pollutants.

(4) Where coliform bacteria are present in a discharge, disinfection shall be required in accord with WP-4-1, Section 3 (4).

Section 3. All existing facilities shall satisfy applicable sections of this regulation or be committed to a compliance schedule which will achieve the same result. New facilities shall satisfy Sections 1 and 2 upon commencing operations.

Section 4. (1) All permits on existing facilities shall be reviewed to insure that they satisfy the requirements of Sections 1, 2 and 3. When the permit for an existing facility is reviewed, the person(s) responsible shall be notified to submit an application for a permit anew with such supporting information as may be required by the Department.

(2) Upon notice of review, persons failing to submit a complete application within 60 days shall be in violation of this regulation unless an extension is granted by the Department.

Section 5. The Department shall refuse to issue a permit to any applicant where the discharge, in the judgment of the Department, does not conform to the Policy of the Commonwealth as set forth in KRS Chapter 224.

Adopted: Nov. 5, 1973
Filed: Nov. 8, 1973
Effective: Dec. 8, 1973

PL 92-500

Public Law 92-500, enacted on October 18, 1972, sets a July 1, 1977 deadline for industries to have in operation the best practicable control technology currently available and for municipalities to complete construction of facilities providing secondary treatment. (Secondary treatment being defined as 85% removal of BOD and suspended solids or effluent BOD and suspended solids limited to 30 milligrams per liter (mg/l) and minimum dissolved oxygen being 5 mg/l.)

Existing Water Quality

Water quality in the basin has been estimated from data collected at several locations within the LCRB. These data have limited dependability for analytical purposes due to the short duration of records and the small numbers of samples analyzed. However, a general water quality can be described using even these limited resources. Water quality records for the LCRB have been summarized in Appendix A, Exhibit A-1t. These records were taken from the U.S. Environmental Protection Agency STORET System.

Recently, the Kentucky Department for Natural Resources and Environmental Protection reported in the Kentucky Water Quality Report to Congress that the water quality in the main stem of the Cumberland River and Lake Barkley "is of uniform excellent quality." Data supplied by the U.S. Army Corps of Engineers and by the Tennessee Valley Authority tend to support this statement. Trace elements and heavy metals concentrations in the Cumberland River and Lake Barkley are all below the Federal-Kentucky Water quality limits set by WP-4-1.

Tributaries within the basin show an extremely good water quality based on the STORET data available. Dissolved solids range from 125 mg/l to 418 mg/l with a mean value around 235 mg/l. This concentration of solids meets the Kentucky standards for all areas of use. Limestone, the predominant underlying bedrock in the basin, contributes to the dissolved solids load considerably in the form of calcium carbonates, or hardness. Hardness in the basin ranges from 150 mg/l to 864 mg/l with the mean around 260 mg/l, and is attributable to the solubility of Calcium and Magnesium salts present in the underlying rock formations. Dissolved solids not due to hardness are generally potassium and sodium chlorides and are approximately 10% of the total dissolved solids.

The Lower Cumberland Basin is in an area where coal mining, and its concurrent water quality problems is practically non-existent. Mining activities are all north and east of the LCRB. Acid mine drainage is therefore not a problem as shown by the pH values in the streams. A pH of less than 5 is generally considered acid while a pH greater than 9 is alkaline. Mean pH values at the monitoring sites covered ranged from 7.2-8.1 indicating the water was neutral to mildly alkaline in nature. This range of values is nearly perfect for aquatic life and drinking water.

Generally speaking, the background water quality in the basin is very good. This scant coverage, however, does not include values for the dissolved oxygen levels in the streams, or the ammonia toxicity levels which are directly responsible for the polluted conditions of so many of the small tributaries within the basin. Municipal, industrial, and domestic sewage sources contribute heavily to the ammonia levels and the oxygen demand placed upon the receiving stream. Discharge permits usually include limits for values of biochemical oxygen demand (BOD) and suspended solids. In the future permits will probably have limiting values set for ammonia (NH_3) concentrations, phosphorous, and even more strict limitations on BOD and suspended solids concentrations.

For purposes of analysis the dissolved oxygen (D.O.) and ammonia (NH_3) levels present in the streams were estimated using several empirical equations in a computerized stream model developed jointly by the University of Louisville and the University of Kentucky. Each significant discharger in the basin was included in the modeling program to estimate the effect of its discharge on the downstream water quality. Results from the modeling program indicate that approximately half the streams in the basin suffer from a dissolved oxygen deficiency due to excessive BOD loads or excessive oxygen demands due to high ammonia concentrations. In order to meet aquatic life standards set in WP-4-1, the DO level must never fall below 5 mg/l.

The data analysis itself included such factors as the seven-day, ten-year low flows of streams receiving effluents from significant dischargers, their milepoints, slopes, and drainage areas which may be examined in Exhibit A-1g.

Groundwater in the basin, exhibits moderate hardness and generally good quality. Major areas of concern are those in which a "Karst" topography dominates. It becomes particularly difficult to protect underground ponds and streams from bacteriological contamination in areas where septic fields are common or discharges flow into caverns and sinkholes.

Organic Loads Affecting Streams

The length of streams studied in the Lower Cumberland River Basin concerning significant organic loading was 360 miles of this total, 17.3 percent or 62 miles were shown to have loads in 1975 which would cause the D.O. levels to drop below the minimum allowable 5 mg/l at a low flow occurrence of once in 10 years for 7 days.

The type of waste and the distance affected in this basin where D.O. levels drop below 5 mg/l are: municipal discharges, 40 miles or 11% of the total; domestic (hospitals, mobile home parks, schools, etc.) 19.6 miles or 6%, and industry 2.4 miles or 0.7%.

Slopes and Elevations of Streams

Slopes and elevations of the major streams occurring in the Lower Cumberland River Basin are listed in Appendix A, Exhibit A-1.1t. These stream slopes are indicative of the rate at which dissolved oxygen levels are replenished in the streams. Stream slopes of 2 feet per mile and less have low reaeration rates; slopes of 2 feet per mile to 6 feet per mile have moderate reaeration rates, and slopes of greater than 6 feet per mile have high reaeration rates.

Of the major streams listed in Exhibit A-1.1t based on slope only; three have low reaeration rates, five have moderate reaeration rates and fourteen have high reaeration rates. Many of the tributary streams have a low slope near their confluence with the Cumberland River which presents problems in maintaining dissolved oxygen levels of 5 mg/l.

Chapter IV

WATER QUALITY MANAGEMENT STATUS

INTRODUCTION

The purpose of this chapter is to explain the existing status of water quality management in the Lower Cumberland River Basin, with the help of certain parameters as defined in the "Guidelines for Preparation of Water Quality Management Plans", published by the U.S. Environmental Protection Agency, and in accordance with the federal legislation.*1

The Guidelines have furnished criteria for subdividing the LCRB into "segment-basins", and for classifying each segment as Water Quality or Effluent, Limitation as listed in Exhibit 4.1t. The methods for formulating current segment priorities have been established in accordance with these guidelines. Further analysis regarding significant discharges in these segments also will be discussed.

A description will be given of the wastewater collection, treatment, and disposal alternatives available to various types of wastewater generators in order to meet the requirements of Federal Law and Kentucky's Water Quality Standards. And, finally, the various types and sources of wastewater residuals, and the methods for managing them will be discussed.

SEGMENT LOCATION AND CLASSIFICATION

The term "segment" (as defined in Article 130.2(m) of Federal Register, Volume 39, Number 107) means "a portion of a basin, the surface waters of which have common hydrologic characteristics (or flow regulation patterns); common natural physical, chemical and biological processes; and common reactions to external stresses, such as the discharge of pollutants."

Segment Location

The Lower Cumberland River Basin was subdivided into 22 segments (sub-basins) based on the following characteristics:

1. Where major differences occured in the average slopes of streams or tributaries for long reaches.

2. Where significant differences in existing water quality occurs in the sub-basins due to point and/or non-point sources of pollution.

3. Where seven day - ten year low flows (Q7-10) for the streams or tributaries draining the sub-basins vary considerably.

4. Where population densities between sub-basins vary considerably.

5. Where the number of significant point and/or non-point discharges vary considerably between sub-basins, having at least one significant discharge in a segment where possible.

These segments were located, then classified individually as Water Quality or Effluent Limitation in accordance with the definitions in the following paragraphs. The locations and classifications of these segments are listed in Exhibit 4.1t and graphically shown by Exhibit 4.2m.

Water Quality and Effluent Limitation Segments

A "Water Quality Segment", as defined in Article 130.11(d)(1), Federal Register, Vol. 39, No. 1.07, is "any segment where it is known that water quality does not meet applicable water quality standards and/or is not expected to meet applicable water quality standards even after the application of the effluent limitations required by sections 301(b)(1)(A) and 301(b)(1)(B) of the Act."*1

An "Effluent Limitation Segment", as defined in Article 130.11(d)(2) of this same reference is "any segment where it is known that water quality is meeting and will continue to meet applicable water quality standards after the application of the effluent limitations required by sections 301(b)(1)(A) and 301(b)(1)(B) of the Act."*1

The effluent limitations, referred to above in sections 301(b)(1)(A) and 301(b)(1)(B) of the Act*1, require that by July 1, 1977, every industrial plant must put into operation the best practicable control technology currently available, and municipalities must construct facilities providing secondary treatment. Secondary treatment is defined as effluent having 85 percent removal of suspended solids (SS) and 5-day Biochemical Oxygen Demand (BOD_5) or a maximum concentration in the effluent of 30 parts per million (ppm) of suspended solids and BOD_5 with a minimum dissolved oxygen concentration, in either case, being 5 ppm.

Being aware that most segments (sub-basins) have certain reaches, or lengths of streams and tributaries, not meeting in-stream water quality standards while other reaches of these same segments do meet standards, each segment classification is based on the main stem of the primary stream or tributary draining the segment. If the main stem water quality is meeting and will continue to meet in-stream standards, as shown by the computer modeling, then the segment is classified Effluent Limited. If the main stem is not meeting and/or is not expected to meet in-stream standards, as shown by its computer modeling, it is classified Water Quality Limited.

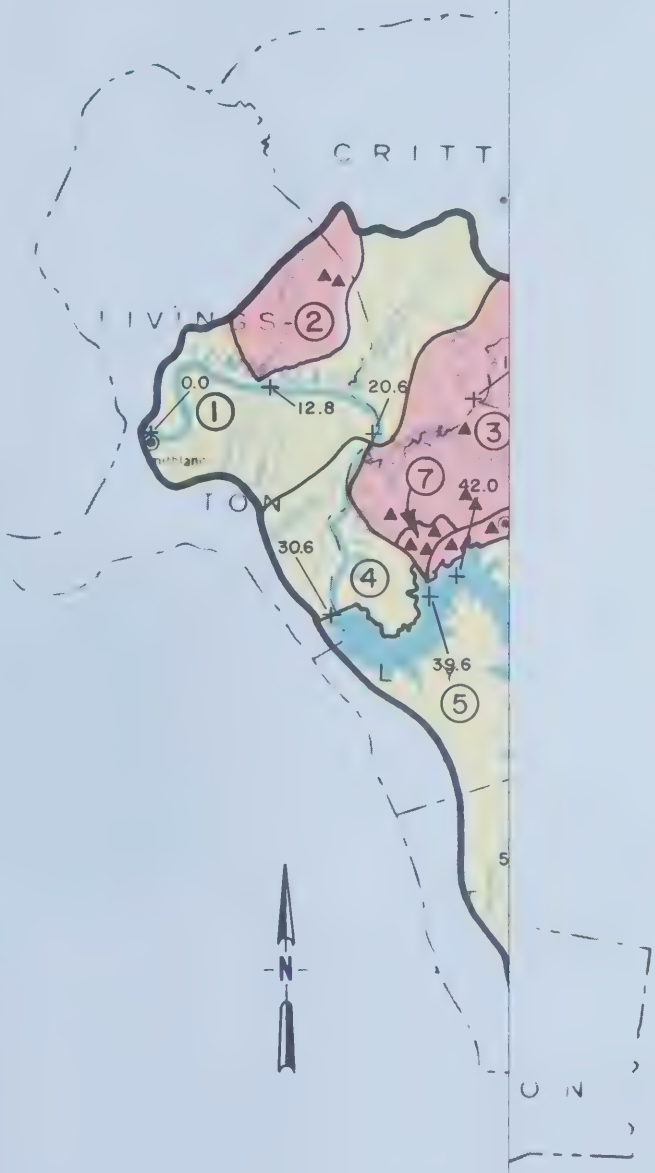
Water Quality Analysis Through Computer Modeling

The means for determining existing and projected

*1-Public Law 92-500, Federal Water Pollution Control Act Amendments

Exhibit 4.1t: Segment Location

Segment	Segment Location	1975 Segment Classification	1975 Segment Priority
LC-1	Cumberland River and tributaries from the confluence of the Ohio River to Livingston Creek	Effluent limited, with McCormick Creek a W.Q.L. sub-reach	76.94
LC-2	Sandy Creek and tributaries from the confluence with Cumberland River to headwaters	Water Quality Limited (WQL)	2.46
LC-3	Livingston Creek and tributaries from the confluence with the Cumberland River to headwaters	Water Quality Limited (WQL)	12.65
LC-4	Cumberland River and tributaries from confluence with Livingston Creek to Barkley Dam	Effluent Limited	12.24
LC-5	Barkley Lake and minor tributaries from Barkley Dam to the Tennessee state line	Effluent Limited	11.08
LC-6	Hammond Creek and tributaries from confluence with Barkley Lake to headwaters	Water Quality Limited	333.45
LC-7	Poplar Creek and tributaries from confluence with Lake Barkley to headwaters	Water Quality Limited	242.64
LC-8	Eddy Creek and tributaries from confluence with Barkley Lake to headwaters	Water Quality Limited	292.77
LC-9	Muddy Fork of Little River from its confluence with Little River to headwaters	Effluent Limited	6.20
LC-10	Little River and tributaries from confluence with Barkley Lake to an Unnamed Tributary at M.P. 49.0	Effluent Limited with Blue Spring Creek a W.Q.L. sub-reach	169.50
LC-11	Little West Fork Red River from Tennessee-Kentucky State line to headwaters	Effluent Limited	3.19
LC-12	Little River and tributaries from M.P. 49 to confluence with South Fork Little River	Effluent Limited	1.45
LC-13	North Fork Little River from confluence with Little River to headwaters	Water Quality Limited	1226.88
LC-14	South Fork Little River from the confluence of Little River to the headwaters	Water Quality Limited	140.83
LC-15	West Fork Red River from the Kentucky-Tennessee State line to the confluence of Montgomery Creek	Water Quality Limited	0.58
LC-16	Montgomery Creek and tributaries from the confluence with West Fork Red River to the headwaters	Water Quality Limited	20.82
LC-17	West Fork Red River from its confluence with Montgomery Creek to the headwaters	Water Quality Limited	13.15
LC-18	Spring Creek and tributaries from the Kentucky-Tennessee State line to headwaters	Effluent Limited	1.72
LC-19	Elk Fork Creek and tributaries from the Kentucky-Tennessee State line to the headwaters	Water Quality Limited	370.01
LC-20	Red River and tributaries from Kentucky-Tennessee State line to the headwaters	Effluent Limited with Whippoorwill Creek and S.Fk. Red River W.Q.L. sub-reaches	267.77
LC-21	Drainage area for Spring Creek, a tributary of Red River in Tennessee	Effluent Limited	-0-
LC-22	Drainage area for Summers Branch, a tributary of Red River in Tennessee	Effluent Limited	-0-



LOWER CUMBERLAND
RIVER BASIN

EXHIBIT 4.2m

SEGMENT CLASSIFICATION

LEGEND

- DISCHARGERS
- SEGMENT BOUNDARY
- SEGMENT CLASSIFICATION
  - WATER QUALITY LIMITED
  - EFFLUENT LIMITED

5 0 10 20

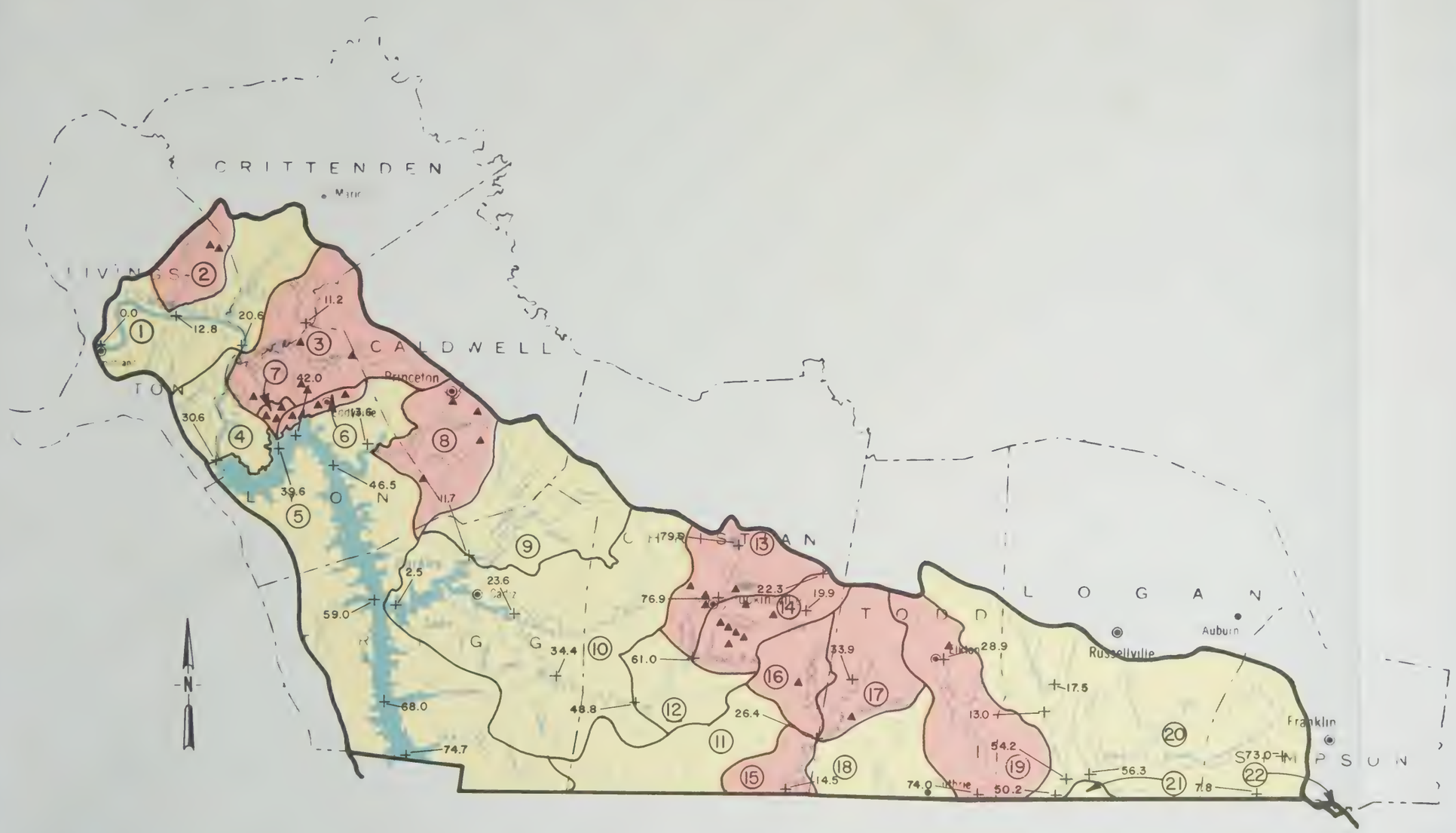
GRAPHIC SCALE IN MILES

Base Data: U. S. Geological Survey

KENTUCKY WATER QUALITY MANAGEMENT PLAN

Prepared for Division of Water Quality
KENTUCKY DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION

G. REYNOLDS WATKINS
CONSULTING ENGINEERS, INC.
Lexington, Bowling Green
& Louisville, Kentucky



LOWER CUMBERLAND RIVER BASIN

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in-stream water quality conditions were developed as a joint effort by personnel from the University of Kentucky and the University of Louisville under contract with the Kentucky Department for Natural Resources and Environmental Protection. The computer modeling of all streams in the LCRB receiving effluent from significant point discharges yielded a printout showing, by stream milepoint, the existing 1975 and the projected 1980 and 1995 in-stream dissolved oxygen levels, ammonia concentration, BOD_5, waste flow, total flow, velocity, slope, and travel time. These existing and projected water quality conditions were checked for classifying the segments as Water Quality or Effluent Limitation.

Significant Discharges - In preparation for the water quality modeling of the streams, existing state records and A.D.D.*[2] plans were searched for all point and non-point waste discharges in the LCRB. All other available records, including county and city plans, were checked for more sources of pollution.

This inventory of discharges included types, characteristics, and amounts of wastes being discharged; types and conditions of existing treatment facilities including treatment efficiencies; proposed treatment facilities; and geographical locations of all discharges. The discharges were all assigned identification members for use in the computer model and for tabulation in this report.

River Milepoint Index - The existing river milepoint system, developed and utilized by the KDNREP, was incorporated into this study. The milepoint system was used to locate any point on any stream or tributary in the LCRB by commencing with the U.S. Corps of Engineers Ohio River Milepoint at its confluence with the Lower Cumberland River. The Ohio River Milepoint was held as the first of the series milepoint number; the second number being the distance in miles advanced upstream on the Lower Cumberland River starting with zero mileage at the Ohio River confluence; the third number being the distance in miles advanced up the next tributary with zero milepoint at its confluence with the Lower Cumberland River, and so on to the point in question.

Using this milepoint system, all discharges located geographically in the LCRB were assigned their unique milepoint numbers. These numbers were used for computer input data and for tabulation in this report.

Multi-Source Dissolved Oxygen Deficit Model - The equations, utilized in the computer model for determination of the assimilative capacities of the streams, are as follows:

$$D = D_o e^{-K_a t} + \frac{K_d}{K_a - K_r}\left(e^{-K_r t} - e^{-K_a t}\right) L_o + \frac{K_n}{K_a - K_n}\left(e^{-K_n t} - e^{-K_a t}\right) N_o$$

$$L = L_o e^{-K_r t}$$

$$N = N_o e^{-K_n t}$$

$$D_o = \frac{D^*Q + bD_wQ_w}{Q + bQ_w}$$

$$L_o = \frac{L^*Q + aW_L}{Q + bQ_w}$$

$$N_o = \frac{N^*Q + aW_N}{Q + bQ_w}$$

$$T = \left(1 - \frac{W_L + W_N}{W_{LO} + W_{NO}}\right) \times 100$$

Where:

t = travel time of pollutant measured from point of discharge, days

D = Dissolved Oxygen deficit at time t, mg/l

D_o = Initial (t=o) Dissolved Oxygen deficit immediately below discharge, mg/l

L, N = Respectively, Ultimate Carbonaceous ($CBOD_u$) and Nitrogenous ($NBOD_u$) Biochemical Oxygen Demand concentration at time t, mg/l

L_o, N_o = Respectively, initial (t=o) $CBOD_u$, $NBOD_u$ concentration immediately below discharge, mg/l

D^* = Dissolved Oxygen deficit immediately upstream of discharge, mg/l

L^*, N^* = $CBOD_u$, $NBOD_u$ concentration immediately upstream of discharge, mg/l

D_w = Dissolved Oxygen deficit of wastewater discharge, mg/l

W_L, W_N + Respectively, $CBOD_u$, $NBOD_u$ discharge release rate after treatment, lb./day

Q_w = Wastewater discharge release rate, 10^6 gal/day

Q = Natural river flow rate plus sum of all upstream wastewater release rates, CFS (Cubic Feet Per Second)

T = Percent wastewater treatment

W_{LO}, W_{NO} = $CBOD_u$, $NBOD_u$ release rate prior to any wastewater treatment, lb/day

a = 0.185 (mg/l X CFS) per lb/day

b = 1.545 CFS per 10^6 gal/day

K_a = Reaeration coefficient of stream, day^{-1}

K_r = Deoxygenation coefficient of stream, including the effect of settling, for CBOD, day^{-1}

K_d = Deoxygenation coefficient of stream for CBOD, day^{-1}

K_n = Deoxygenation coefficient of stream for NBOD, day^{-1}

These equations were programmed in Fortran IV.

*[2]-Pennyrile and Barren River Area Development District Comprehensive Water and Sewer Plans

Design Data Utilized In The Assimilative Capacity Computer Modeling was:

1. Stream Standards

D.O. Saturation at 25°C (Degrees Centigrade) -8.25mg/1
D.O. Water Quality Standard -5.00mg/1
Maximum Allowable D.O. Deficit -3.25mg/1

2. Assumed Water Quality Upstream of Discharge

5-Day BOD - 2.00mg/1
Ammonia-Nitrogen (NH_3-N) - 0.22mg/1
D.O. Deficit - 1.00mg/1

3. Reaction Rates For D.O. Deficit Model (at 25°C)

CBOD Decay Rate, $K_r=K_o$ - per day

Stream Deoxygenation Rate, $K_o=0.018 * 5$ Day BOD of the mixture, $0.1 \leq K_o \leq 0.5$

NBOD Decay Rate, $K_n=0.1 * K_a$, $0.05 \leq K_n \leq 0.3$

4. Stream Velocity and Reaeration Rate (at 25°C)

a. Shallow Streams

$V = 5.63 * (F-0.085) * S * 0.5$, (mile/day) For $F > 0.2$
F = Total stream flow divided by basin area
S = Stream slope, feet/mile

$V = 0.65 * S * 0.5$, mile/day, for $F < 0.2$
V = 0.4 mile/day minimum, 40 mile/day maximum velocity

$K_a = 0.25 + 0.43 * S$ per day

b. Large Rivers and Impoundments

V = Cubic Feet Per Second/Average Cross Section Area, feet/sec

$K_a = 12.9 * V^{0.5}/H^{1.5}$, per day H = mean depth
K_a = 0.075 per day, minimum

5. Sewage Treatment Plant Influent Characteristics

Wastewater Flow Per Capita 100 gal/day
5-Day BOD 200 mg/1
NH_3-N 25 mg/1

6. Sewage Treatment Plant Effluent Characteristics - Various treatment levels were set as realistically achievable, and were investigated by the computer model. The levels of treatment were tested by the computer model for adequate waste removal to meet the required stream standards. These treatment levels and their effluent characteristics are as follows:

Treat. Level	Concentration mg/1 Eff. BOD_5	NH_3-N	D.O.	SF	%BOD_u Removal	Description of Treatment
T1A	30.	20.	4.0	131.0	67.3	High Rate Biol.
T1B	30.	20.	8.0	128.0	67.3	& Aeration
T2A	20.	15.	4.0	93.5	76.4	Biological
T2B	20.	15.	8.0	89.5	76.4	& Aeration
T3A	10.	15.	4.0	78.5	80.0	Biol. + Filtration
T3B	10.	15.	8.0	74.5	80.0	& Aeration
T4A	10.	1.	4.0	15.5	95.3	Complete Bio.Nit.
T4B	10.	1.	8.0	11.5	95.3	& Aeration
T5A	3.	1.	4.0	5.0	97.8	Advanced
T5B	3.	1.	8.0	1.0	97.8	& Aeration

Computer Runs - Two computer runs were made in order to determine existing and projected stream water quality and to set the required treatment levels for significant discharges.

The first computer run utilized input data from all significant point discharges inventoried in the LCRB. The input data consisted of existing 1975, and projected waste discharge flows for 1980 and 1995. The river mile points and 7Q10 stream flows at these discharge points were also entered along with existing effluent characteristics, BOD_5, NH_3-N, and D.O. concentrations. This computer run analysed the existing (1975) stream water quality; then, assuming secondary treatment (BOD_5-30 mg/1, D.O.-5 mg/1) to be achieved by 1977 (in accordance with P.L. 92-500), analyzed the projected 1980 and 1995 in-stream water quality.

The second computer run was utilized for a rerun of the 1975 in-stream water quality with modified input from current discharge inventories. The primary purpose of this run, however, was accomplished by choosing the expected treatment level required and determing if in-stream water quality would then be met in 1980. If the treatment level chosen was not adequate, another computer run was used to evaluate an alternative treatment level.

Ammonia Toxicity - The effect of ammonia-nitrogen on the oxygen demand from waste effluents has been considered by the Dissolved Oxygen Deficit Model which analyzed, by use of computer, the dissolved oxygen condition in the streams. Another effect from in-stream ammonia-nitrogen concentration is the toxicity due to the unionized ammonia-nitrogen concentration. It was determined in the monthly consultant's meetings, with input from the E.P.A. Region IV office, that NH_3-N concentrations should not exceed 4 mg/1 in order to avoid in-stream ammonia toxicity.

In some cases, this restriction on NH_3-N effluent concentration has demanded a higher level of treatment than required to meet the D.O. in-stream standards, and with this higher level treatment, even on zero low flow streams, stream standards will be met regardless of the amount of effluent.

1975 Segment Priorities

After locating and defining the segments in the LCRB, a method was needed for determining the relative impact of waste loading on these individual segments and on the segments making up the other Kentucky River Basins. The following paragraphs outline the procedures used in setting the 1975 segment priorities for all the river basins in Kentucky. The list of LCRB segments and their priorities is shown by Exhibit 4.1t.

Segment Priority Formula

The Kentucky Department for Natural Resources and Environmental Protection developed a formula to be used by all the River Basin Planning consultants in determining the segment priorities in their basin under study.

This formula incorporates the impact of segment population and the total effluent waste load in the segment (the sum of the individual discharges) which exceeds that shown to be allowable by the 1980 computer model in order to meet in-stream water quality standards, and 1977 effluent standards set by P.L. 92-500.

The Segment Priority Formula, and an explanation of its terms, is as follows:

$$\text{Priority} = \frac{P}{1000} + (BOD_5 + SS + NH_3 + PO_4 + \text{Metals}) + T + NP$$

P - Population Affected - People are affected by water pollution in at least two ways:

1. Pollution may reduce the economic, recreation and aesthetic values of the water to persons who might otherwise gain or benefit from clean water.

2. People will be required to pay, either directly or indirectly for pollution control.

Therefore, it is reasonable to include the population in the segment, which responds to the federal regulations.

Number - Segment population divided by 1000.

BOD_5 - Five Day Biochemical Oxygen Demand, depletes the life giving oxygen from the streams.

SS - Suspended Solids contribute to the sedimentation load in the stream which can form a benthic demand (Oxygen demand from decomposing sludge on bottom of streams)

NH_3 - Ammonia-Nitrogen Contributes heavily to the oxygen depletion in a stream due to the conversion of the nitrogen to nitrites and nitrates. The nitrogen also contributes to water enrichment which makes algal growth in pools and impoundments more likely to occur.

PO_4 - Phosphates cause water enrichment due to phosphorous, a vital element for algal cell growth.

Metals - Certain metals such as Chromium, Mercury, Lead, Arsenic, Barium, Silver, and others are toxic to fish and waterborne organisms at low levels of concentration.

Numbers for BOD_5, SS, NH_3, PO_4, are determined by the difference in the most restrictive requirement and the amount discharged in pounds per day.

To determine the most restrictive requirement, three informational sources must be examined:

1. The definition of secondary waste treatment, which is basically 30mg/1 BOD_5 and 30mg/1 of suspended solids supplemented by an ammonia-nitrogen limitation of 4mg/1 in the receiving stream, and a minimum D.O. of 5 mg/1.

2. The NPDES permit (National Pollutant Discharge Elimination System) which contains specific requirements for BOD_5, suspended solids, and in some cases ammonia-nitrogen.

3. The waste load allocation from the "Kentucky Waste Load Allocation Model" developed by U.K./U.L.

Number for Metals applies to industries and is computed as the difference between the waste water amounts and best practical treatment or NPDES limitations, in pounds per day.

T - Thermal - Cooling water effects are included in the segment priority formula using the degrees Fahrenheit above allowable, times the flow in million gallons per day.

NP - Non-point Sources - The non-point source factor is a term which allows for 100 points where significant non-point sources occur. The term significant is to be applied using the following information for judgement. Note that only 100 points are allowed, regardless of the number of significant non-point sources.

1. Acid mine drainage will be considered significant when the stream is continuously impregnated with acid mine drainage to the extent that the pH is depressed below pH 6 at least 90% of the time or pH 5 at least 50% of the time.

2. Strip mining will be considered a significant impact if the present control techniques utilizing sedimentation basins is not sufficient to prevent a substantial increase in suspended solids in the main stem of the river.

3. Combined sewers will be considered significant when the yearly average combined sewage overflow at least equals the treated effluent flow.

4. Surface runoff from urban areas will be considered significant when the population affected $\frac{P}{1000}$ is 10 or more.

DEVIATION FROM NATIONAL PRIORITIES

At the present time, there are no formal national priorities governing specific areas, reaches of streams, or dischargers in the Lower Cumberland River Basin. Should such priorities be set in the future, this continuing plan has the flexibility to adjust the treatment requirements for one or all of the dischargers,

and analyze the effects by use of the established computer model.

SIGNIFICANT MUNICIPAL DISCHARGES

There are eleven significant municipal discharges in the LCRB. These discharges are located geographically by Exhibit 4.4m and are tabulated in Exhibit 4.3t along with the following pertinent information:

...Owner of discharging facility
...Location of discharge by county and segment
...The receiving water and its milepoint at the discharge
...Water quality violations caused by the effluent
...The 1975 Abatement Priority Number
...NPDES Permit Number and its expiration date
...The pollution abatement compliance schedule

Method For Significant Municipal Discharge Designation

"Significant Discharge" means "any point source discharge for which timely management action must be taken in order to meet the water quality objectives for the basin within the period of the operative basin plan. The significant nature of the discharge is to be determined by the state, but must include, at a minimum, any discharge which is causing or will cause serious or critical water quality problems relative to the segment to which it discharges."*1 This definition applies also to Domestic, Industrial, and non-point discharges.

The River Basin Planning Consultants, during the monthly Frankfort meetings and with guidance from the KDNREP, decided that the determination of significant discharges should be left to the discretion of the individual basin consultants, but that most municipalities would be considered as significant.

All of the municipal discharges in the LCRB were considered significant, with the low average daily flow of 32,000 gallons per day being at Smithland, and the high average daily flow being over three million gallons per day at Hopkinsville.

Method For Formulation of Abatement Priority

A formula for determining municipal facility priorities was developed by the KDNREP. This formula incorporates in the priority calculations the segment priority (excluding metals, thermal and non-point sources contribution), and the municipal needs determination.

The estimated cost of the project is used with the proportion of that cost assigned to Treatment, Infiltration/Inflow, Interceptor, Collection Sewers, and Combined Sewers needs. These cost proportions are then multiplied by the appropriate factors and these five products summed up to give the municipal construction grant priority as follows:

$$F.P. = \sum_{n=1}^{n=5} (F_{needs} \times F_{portion} \times P_S)$$ where:

F.P. = Facility Construction Grant Priority

n = 1 to 5 (needs types as shown below)

F_{needs} = Factor for needs type

$F_{portion}$ = Portion of total cost for type of need.

P_S = Segment Priority (adjusted for segment portion affected)

n	Needs Type	$F_{portion}$ (example)	F_{needs}
1	Treatment	.4	F_T
2	Interceptors	.2	2.0
3	Collectors	.2	1.0
4	Infiltration/Inflow	.1	1.5
5	Combined Sewers	.1	0.5

F_T = Treatment Factor

Treatment	F_T
T1	2.0
T2	2.5
T3	3.5
T4	4.5
T5	6.0

NPDES Permits

Three of the eleven municipal discharges do not currently have NPDES permits on file with the KDNREP. Those with permits have expiration dates falling in 1977.

The compliance schedules for these discharges are all set for July 1, 1977 at which time all municipal discharges are required by P.L. 92-500 to have secondary treatment as a minimum and more sophisticated treatment where required to achieve stream water quality standards.

SIGNIFICANT DOMESTIC DISCHARGES

There were found to be 18 significant domestic discharges in the LCRB with flows ranging from 5,000 gallons per day to 330,000 gallons per day. These discharges are all located geographically by Exhibit 4.6m, and listed by their owners in Exhibit 4.5t along with the following information:

...Location by county and segment
...Receiving water and discharge location by milepoint
...List of water quality violations
...NPDES permit numbers and expiration dates
...Pollution abatement compliance schedules

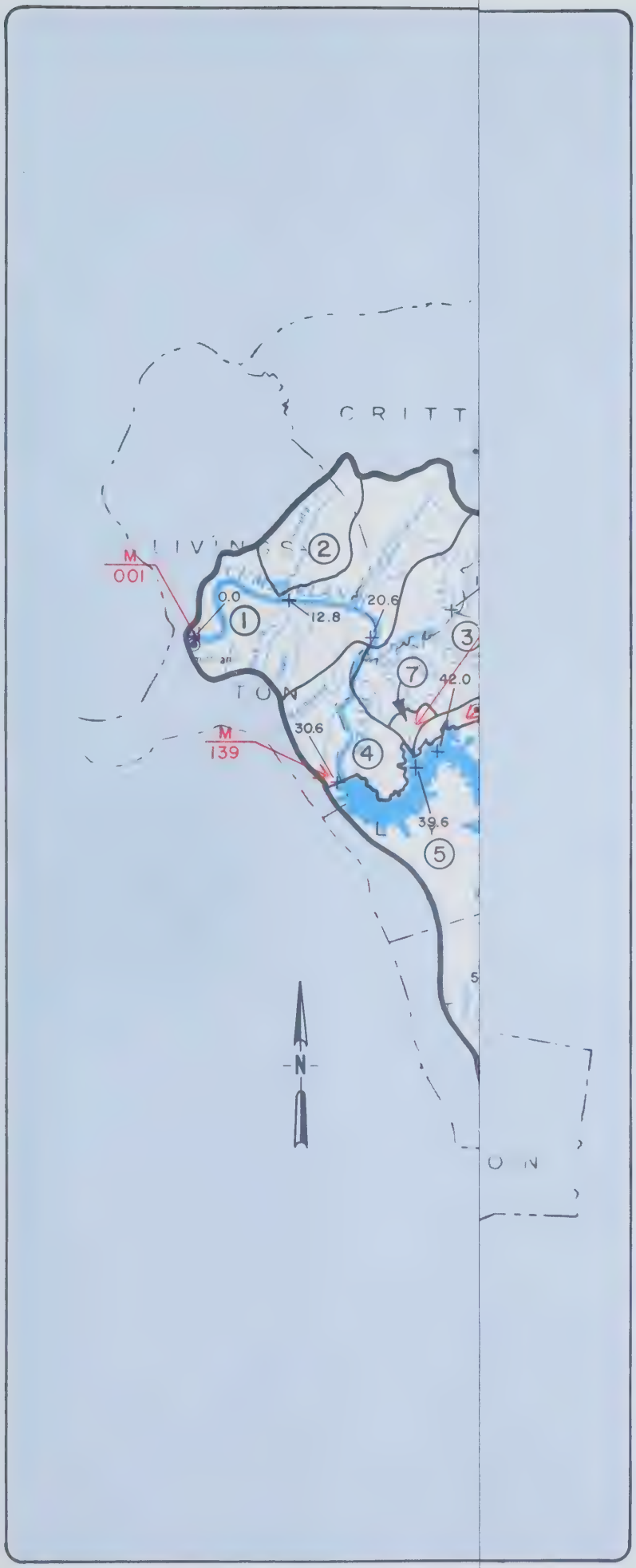
*1-Federal Register, Vol. 39, No. 107, Part II E.P.A. Water Quality Management Basin Plans, Article 130.2(n).

Exhibit 4.3t: Significant Municipal Dischargers

Discharge Name	Location		Receiving Water	1975 Abatement Priority	Water Quality Violation	NPDES Permit		
	County	Segment				Number	Expiration Date	Compliance Schedule
Hopkinsville STP 068	Christian	13	N. Fork Little River, M.P.- 58.90/59.00/71.60	1367.7	D.O.	KY0023388	6/30/77	7/1/77
Elkton STP 071	Todd	19	Elk Fork Creek M.P.- 58.90/ 125.30/33.30/ 29.10	917.6	D.O. NH_3-N	---	--	7/1/77
Princeton STP 043	Caldwell	8	Eddy Creek M.P.- 58.90/ 46.50/21.60	695.3	D.O. NH_3-N	---	--	7/1/77
Adairville STP 069	Logan	20	S. Fork Red River M.P.- 58.90/ 125.30/56.30/5.3	644.0	D.O. NH_3-N	KY0020885	6/30/77	7/1/77
Eddyville STP 040	Lyon	6	Hammond Creek M.P.- 58.90/ 42.00/2.80/0.30	565.2	D.O. NH_3-N	KY0027979	6/30/77	7/1/77
Kuttawa STP 011	Lyon	7	Poplar Creek M.P.- 58.90/ 39.70/1.80/0.60	485.3	D.O. NH_3-N	KY0020419	6/30/77	7/1/77
Cadiz STP 048	Trigg	10	Little River M.P.- 58.90/ 59.00/17.40	287.3	None	KY0026891	6/30/77	7/1/77
Smithland STP 001	Livingston	1	McCormick Creek M.P.- 58.9/3.8/ 1.5/0.2	153.9	D.O.	KY0025836	6/30/77	7/1/77
Trenton STP 073	Todd	17	Big West Fork M.P.- 58.90/ 125.30/1.30/ 29.30/1.40/0.30	59.2	None	---	--	7/1/77
Pembroke STP 072	Christian	16	Montgomery Creek M.P.- 58.90/ 125.30/1.30/ 26.04/6.0	44.7	D.O. NH_3-N	KY0024813	6/30/77	7/1/77
Lake City STP 139	Livingston	4	Cumberland River M.P.- 30.5	19.6	None	KY0027227	6/30/77	7/1/77

Exhibit 4.5t: Significant Domestic Dischargers

Discharger Name and Number	Location		Receiving Water	Water Quality Violation	NPDES Permit		
	County	Segment			Number	Expiration Date	Compliance Schedule
Salem Community Hospital 02003	Livingston	2	Cox Spring Branch Sandy Creek 12.8/21.0	None	---	--	7/1/77
Kentucky State Penitentiary 02012	Lyon	5	Lake Barkley 43.40	None	KY0026255	6/30/77	7/1/77
Dunbar and Sullivan 02020	Lyon	5	Lick Creek 42.90/2.50	D.O.	---	--	7/1/77
KOA Campground 02022	Lyon	5	Eddy Creek 46.50/9.00/0.60/ 0.60/0.2	None	---	--	7/1/77
Barkley Inn 02025	Trigg	5	Lake Barkley 62.90	None	---	--	7/1/77
Lake Barkley State Park 02026	Trigg	10	Little River 59.00/4.40	None	KY0024473	12/31/79	7/1/77
Lakeview Camp Area 02030	Trigg	5	Lake Barkley 58.50	None	---	--	7/1/77
Stubblefield Apts. 02037	Trigg	5	Lake Barkley 62.80	None	---	--	7/1/77
Bar-X Mobile Home Park 02041	Lyon	7	Popular Creek 39.20/2.20/0.80	D.O.	---	--	7/1/77
Shady Lawn Nursing Home 02052	Trigg	10	U.T. to L. River 59/11.7/11.3/1.6/ 0.6	None	---	--	7/1/77
Hopkinsville-Christian County Airport 02056	Christian	14	So. Fork Little River 59.00/61.00/10.30	D.O.	---	--	7/1/77
Western State Hospital 02057	Christian	14	Little River 59.00/61.00/10.50	D.O.	---	--	7/1/77
Parklawn Nursing Home 02064	Christian	13	Sinkhole U.T.-North Fork Little River 59.0/72.1/0.7/1.0	D.O.	---	--	7/1/77
Olmstead School 02070	Logan	20	Vicks Branch 125.30/54.20/11.90/ 0.90/0.50	D.O.	---	--	7/1/77
Salem Nursing Home 02074	Livingston	2	U.T. Sandy Creek 12.8/21.0	None	KY0024911	9/30/77	7/1/77
Lake Barkley State Park 02076	Trigg		Blue Spring Creek 59.0/2.5/2.2	None	KY0024473	12/31/79	7/1/77
Bend of Rivers Company 02077	Lyon	5	Lake Barkley 39.1/0.65	None	KY0024686	1/29/80	7/1/77
Meadow Brook Park 02077	Christian	14	U.T. So. Fork Little River 61/59/2.3/2.1	D.O.	---	--	7/1/77



LOWER CUMBERLAND
RIVER BASIN

EXHIBIT 4.4m

SIGNIFICANT MUNICIPAL DISCHARGERS

LEGEND

DISCHARGERS

M
00

MAJOR (OVER 1.0 MGD)

M
00

PRINCIPAL (LESS THAN 1.0 MGD)

5 0 10 20

GRAPHIC SCALE IN MILES

Base Data: U.S. Geological Survey

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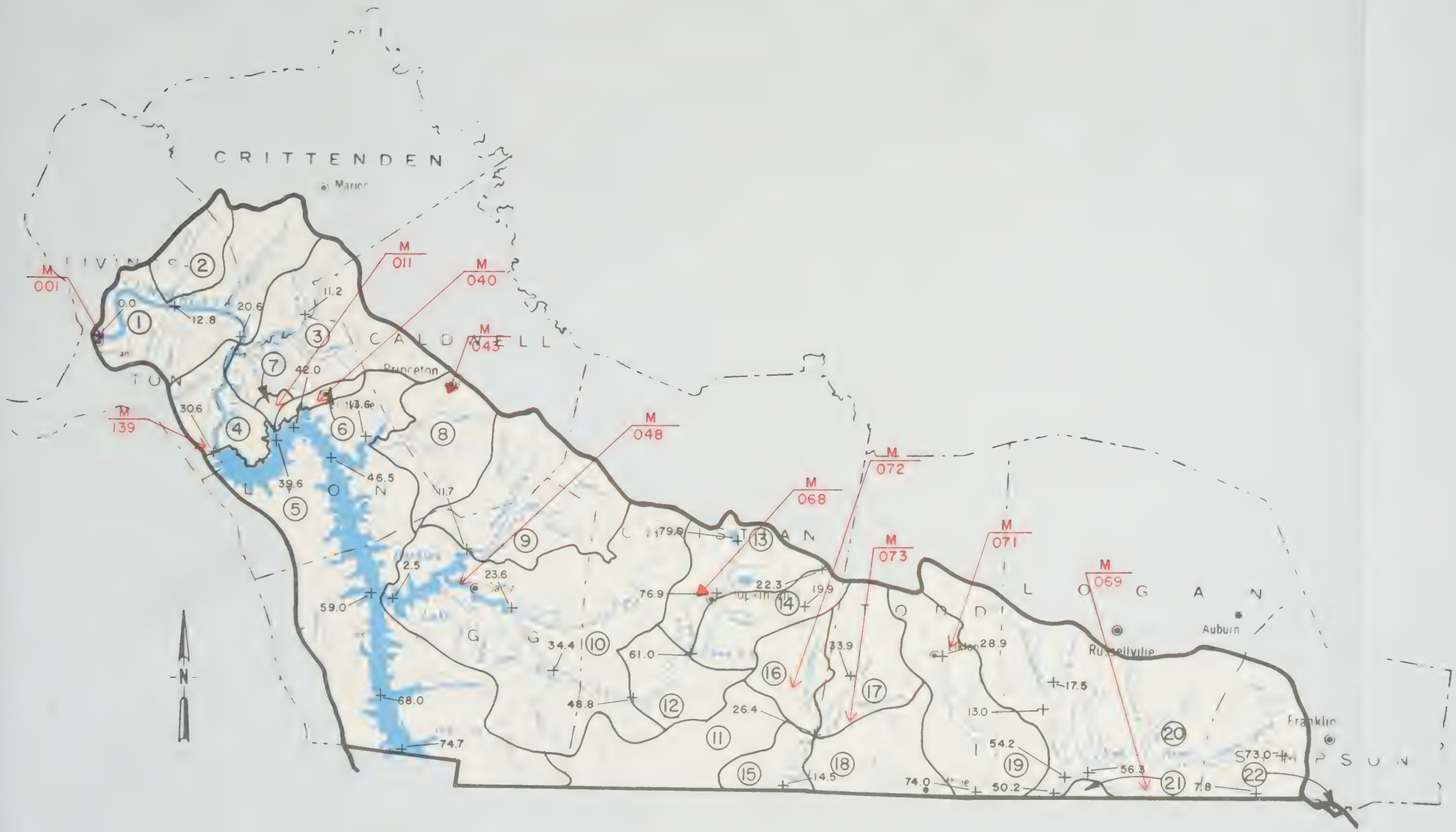
Lexington, Bowling Green
& Louisville, Kentucky



LOWER CUMBERLAND RIVER BASIN

EXHIBIT 4.4m

SIGNIFICANT MUNICIPAL DISCHARGERS

LEGEND

DISCHARGERS

M 00 — MAJOR (OVER 1.0 MGD)

M 00 — PRINCIPAL (LESS THAN 1.0 MGD)

5 0 10 20

GRAPHIC SCALE IN MILES

Base Data: U.S. Geological Survey

KENTUCKY WATER QUALITY MANAGEMENT PLAN

Prepared for Division of Water Quality

KENTUCKY DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION

G. REYNOLDS WATKINS CONSULTING ENGINEERS, INC.

Lexington, Bowling Green & Louisville, Kentucky

LOWER CUMBERLAND RIVER BASIN

EXHIBIT 4.6m

SIGNIFICANT DOMESTIC DISCHARGERS

LEGEND

DISCHARGES

- D 00 — MAJOR (OVER 1.0 MGD)
- D 00 — PRINCIPAL (LESS THAN 1.0 MGD)
- I 00 — MAJOR (OVER 1.0 MGD)
- I 00 — PRINCIPAL (LESS THAN 1.0 MGD)

5 0 10 20

GRAPHIC SCALE IN MILES

Base Data: U.S. Geological Survey

KENTUCKY WATER QUALITY MANAGEMENT PLAN

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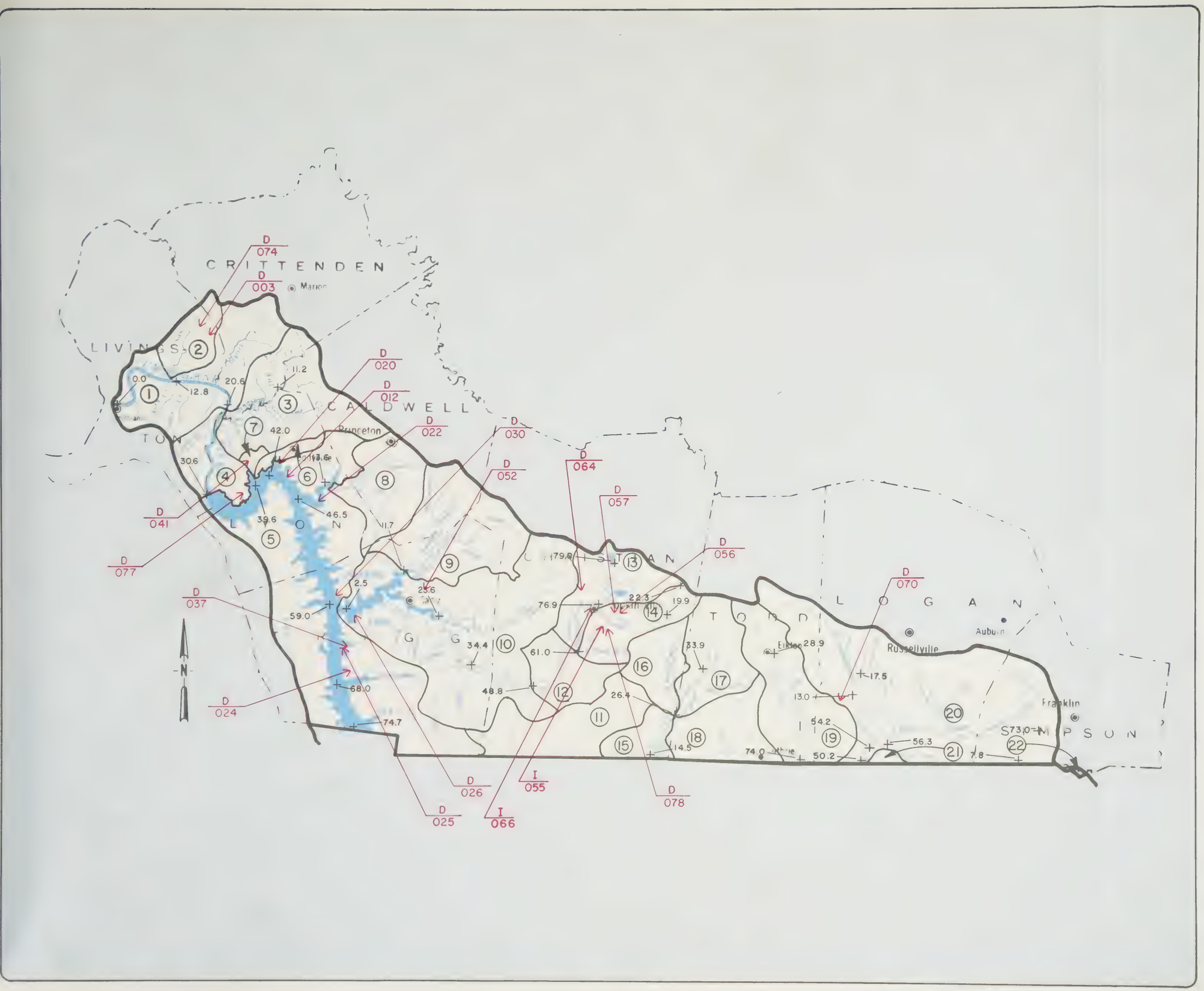

LOWER CUMBERLAND RIVER BASIN

EXHIBIT 4.6m

SIGNIFICANT DOMESTIC DISCHARGERS

LEGEND

DISCHARGES

- D 00 — MAJOR (OVER 1.0 MGD)
- D 00 — PRINCIPAL (LESS THAN 1.0 MGD)
- I 00 — MAJOR (OVER 1.0 MGD)
- I 00 — PRINCIPAL (LESS THAN 1.0 MGD)

Base Data: U. S. Geological Survey

KENTUCKY WATER QUALITY MANAGEMENT PLAN

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Lexington, Bowling Green & Louisville, Kentucky

Method For Significant Domestic Discharge Designation

As mentioned earlier, the significant discharge designation was left to the individual basin consultants' discretion. After reviewing the domestic discharge inventory it was decided that only discharges of 5,000 gallons per day or greater should be considered as significant.

Five thousand gallons per day is a relatively low waste flow, but was chosen in order that a moderate portion of the domestic discharges would be recognized. Domestic flow projections in many cases are difficult to predict for future growth, but can be seen to have potentially higher effluent flows.

Abatement Priorities

No facility priority formula has been developed for domestic discharges in Kentucky since there are no construction grant funds available for other than publicly owned and operated facilities.

Water Quality Violations

Eleven of these eighteen discharges as shown in Exhibit 4.5t have no water quality violations. This is due to several of them being located adjacent to and discharging into Lake Barkley which maintains a high dissolved oxygen level due to abundant dilution. Others of these discharges have their relatively low flows discharging into continuously flowing streams, thus providing much dilution and aeration.

NPDES Permits

Recorded NPDES Permits are Available for only five of the discharges, and their expiration dates are all June 30, 1977.

The compliance schedules for these discharges are all set for July 1, 1977 in accordance with P.L. 92-500, requiring secondary treatment by that date.

SIGNIFICANT INDUSTRIAL DISCHARGES

There are five Significant Industrial Discharges in the LCRB, ranging from 7,500 gallons per day to 84,000 gallons per day. These discharges are all located geographically by Exhibit 4.4m and listed by their owners in Exhibit 4.7t with the following information:

...Location by county and segment
...Receiving water and discharge location by mile-point
...List of water quality violations
...NPDES permit numbers and expiration dates
...Pollution abatement compliance schedules

Method For Significant Industrial Discharge Designation

It was decided to use a minimum discharge of 5,000 gallons per day to denote significant discharges. This low flow was considered significant because of the potential toxic wastes concentrations from industry. The largest of these dischargers, Thomas Industries, pretreats their waste for Cyanide and metals removal.

Abatement Priorities

As in the case for domestic discharges no facility priority formula has been generated for industrial discharges in Kentucky since no construction grant funds are available for nonpublic facilities.

Water Quality Violations

Two of these industrial discharges, as shown in Exhibit 4.7t, cause in-stream dissolved oxygen levels to fall below water quality standards. The other three show no water quality violation.

Exhibit 4.7t: Significant Industrial Dischargers

Discharger Name and Number	Location		Receiving Water	Water Quality Violation	NPDES Permit		
	County	Segment			Number	Expiration Date	Compliance Schedule
ITT Grinnel Corp. 02044	Caldwell	8	Eddy Creek 46.5/14.0/5.8/ 1.0/1.2	None	App. # KY0022225	---	7/1/77
Hoover Manufacturing Company 02051	Trigg	10	Pond-Groundwater Sinking Fork	None	---	--	7/1/77
U.S. Machine 02055	Christian	14	U.T. - S. Fork Little River 59.0/61.0/3.8/1.1/ 1.7	D.O.	KY0003786	9/30/78	7/1/77
Thomas Industries 02066	Christian	13	U.T. - N. Fork Little River 59.0/72.9/0.3	D.O.	KY0003565	2/13/80	7/1/77
Koppers Industry 02080	Trigg	18	58.9/125.3/1.3/ 6.0/11.0/4.1	None	---	--	7/1/77

NPDES Permits

Two of the Significant Industrial Discharges have recorded NPDES permits with one expiring in 1978 and the other in 1980. One other of these dischargers has applied for an NPDES permit and there is no NPDES record of the other two of these discharges.

The recommended compliance schedules for these discharges are all set for July 1, 1977 in accordance with P.L. 92-500 for best practicable control technology by that date.

SIGNIFICANT NON-POINT SOURCES

The Lower Cumberland River Basin is fortunate to have few problems in relation to non-point sources of pollution.

Acid mine drainage, which is a common non-point source of pollution for several of the drainage basins in Kentucky, is negligible in the LCRB. This is evidenced by the water quality data shown in Appendix A-1. There are no seriously low pH values recorded from stream samples taken in the LCRB.

A significant non-point source of pollution is defined as "a hydrologic subdivision in which dispersed sources of pollution present a significant water quality management problem."

The only non-point source of pollution in the LCRB, classified as significant, is the Hopkinsville Urban Area of approximately 12 square miles, which lies in Segments 13 and 14, as shown by Exhibit 4.4m. Urban storm water runoff is classified as a significant non-point source of pollution for urban areas of 10,000 population or greater as established by the KDNREP.

Urban Runoff Pollutants

The most common pollutants found in urban runoff include: dust, dirt, pathogens, fertilizers, pesticides, battery acid, rubber, grease, oil, animal and bird droppings, heavy metals, salts, sand, gravel, coal, leaves, paper products, plastics, glasswares, and metals.

Non-Point Source Management

The most effective means for controlling urban runoff pollutants to streams is by municipal ordinances. Some ordinance requirements and municipal services that will greatly reduce urban runoff pollutants are as follows:

1. Regular street sweeping schedules to remove grit, dust, bird droppings and litter.
2. Regular leaf collection and disposal in the fall of the year.
3. Siltation prevention ordinances requiring silt retention basins or other silt trapping methods downstream of construction sites and using stage grading, seeding, and sodding procedures.
4. Ordinances to control dumping and littering.
5. Installation of adequate waste receptacles on public streets.

Target Dates For Non-Point Source Controls

Non-point source controls are regulated through 208 Areawide Waste Treatment Management Planning. Target dates are set in 208 planning for these controls, but the LCRB is not yet part of a 208 Designated Planning Area, and is not expected to be in the near future.

DISPOSAL OF TREATMENT PLANT RESIDUALS

The primary sources of sewage sludge generation in the lower Cumberland River Basin are tabulated in Exhibit 4.8t. All municipal sewage treatment plants are listed along with the only domestic wastewater discharges having a flow greater than 50,000 gallons per day. Sewage discharges less than 50,000 gallons per day generate less than 3 cubic feet of dry sludge per day and were, therefore, not listed.

Character of Sewage Residuals

Available data indicates that most wastewater residuals (sludge) in the LCRB is typical in its physical-chemical makeup.

As shown in Exhibit 4.8t, most sewage plant sludges in the LCRB are digested, then dried on sand beds and finally disposed of by application to farm land. Surface disposal of dried sludge is becoming more common because of landfill costs and because of the agricultural nutrients available in the sludge.

Projected Sewage Residual Generation and Ultimate Disposal

Projected 1980 waste flows and dry sludge volumes generated are listed in Exhibit 4.8t for the municipal sewage treatment plants and major domestic plant in the LCRB. The sludge volumes were calculated assuming the following:

1. Suspended solids in raw sewage, 0.2 lb. per capita/day.
2. Suspended solids removal by primary treatment, 60%.
3. Volatile content of raw sludge solids, 75%.
4. Reduction in volatile matter by digestion, 55%.
5. Solids content of digested sludge, 8%.
6. Solids content of dried sludge, 40%.
7. Volume of dried sludge is half that of digested sludge.

Industrial sludge generation was found to be insignificant and disposed of by the industries from their pretreatment processes.

This table also lists each county's population (1980) that lies within the LCRB and the sludge volume that can be generated by this population. The 1980 sludge volume listed for each county is the maximum estimated sludge generation that would occur from domestic sewage if treated by conventional methods.

Exhibit 4.8t: Projected Sewage Sludge Disposal Needs For Municipal Plants and For Domestic Plants Over 5,000 Gallons Per Day

County: Population in LCRB*3 Discharges	Waste Flow (1980) Gallons Per Day	Sludge Volume*1 (Cubic Feet/Day)	Existing Methods of Sludge Disposal
Caldwell: 9,998		70*2	
Princeton S.T.P.	758,000	53	Anaerobic digestion, sludge, drying beds, then farm spreading.
Christian: 56,723		397*2	
Hopkinsville S.T.P.	4,220,000	295	Anaerobic digestion, sludge drying beds, then farm spreading.
Pembroke S.T.P.	73,000	5	Aerobic digestion, sludge drying beds, then farm spreading.
Livingston: 3,159		22*2	
Lake City S.T.P.	60,000	4	Aerobic digestion, sludge drying beds, then farm spreading.
Smithland S.T.P.	38,000	3	Aerobic lagoon.
Logan: 7,970		56*2	
Adairville S.T.P.	109,000	8	Aerobic digestion, sludge drying beds, then farm spreading.
Lyon: 6,000		42*2	
Eddyville S.T.P.	214,000	15	Anaerobic digestion, sludge drying beds, then farm spreading.
Kuttawa S.T.P.	49,000	3	Anaerobic digestion, sludge drying beds, then farm spreading.
Ky. State Penitentiary S.T.P.	330,000	23	Aerobic digestion, sludge drying beds, then farm spreading.
Todd: 7,035		49*2	
Elkton S.T.P.	164,000	11	Anaerobic digestion, sludge drying beds, then on-site trench burial.
Trenton S.T.P.	49,000	3	Aerobic digester, no drying beds, farm spreading.
Trigg: 8,620		60*2	
Cadiz S.T.P.	197,000	14	Aerobic digestion, sludge drying beds, then farm spreading.
Crittenden: 1,310		9*2	
Simpson: 2,407		17*2	

*1 Assumes 40% solids by weight.
*2 Total estimated sewage sludge equivalent generated in the portion of this county in the LCRB. This estimate includes all human waste regardless of current method of disposal (sewage treatment plants, septic tanks, cess pools, pit privies, etc.).
*3 County population projected for 1980 within the LCRB.

As shown by Exhibit 4.8t, ultimate sludge disposal in the LCRB is accomplished predominately by the surface land disposal, usually for agricultural purposes. Available data indicated no sewage sludge in the LCRB being disposed of in licensed landfills or any significant landfills.

Sites Licensed For Wastewater Residuals

Landfill sites are located as non-point sources of pollution on the segment maps in Appendix B. Some of these sites may be potential sites for future sewage sludge disposal.

Current state regulations are not clear as to what sludges, if any, may be disposed of in licensed sites, but indications are that if free from high concentrations of toxic metals and in a "dry" (unable to pour) condition, they will be acceptable for landfills in the future.

Capacities for existing licensed and unlicensed landfill sites in the LCRB are not available.

WATER TREATMENT PLANT RESIDUALS

Most existing water treatment plants in the LCRB currently discharge their backwash waters to the stream providing their water supply. This procedure is being discouraged by the KDNREP by requirements for backwash water lagoons before plans for new or expanded plants are approved.

Lack of information on the amounts of solids backwashed prevents our estimating in this section the potential quantities of sludge generated by the water treatment plants. Further study should be given this matter as information is compiled for these water plants.

WASTEWATER CONTROL NEEDS

Wastewater treatment technologies that will meet increasingly stringent effluent standards are developed in this section. In all, ten effluent standard categories are defined, and their relationships to effluent quality objectives are discussed. Following this general discussion, the effectiveness of the various technologies in acheiving BOD_5 and suspended solids removal, ammonia nitrogen removal, nitrogen removal, and phosporus removal is considered. Possible upgrading alternatives for existing activated sludge, fixed film and lagoon wastewater treatment systems are then, presented. The section closes with brief descriptions of the unit operations and unit processes which make up the wastewater treatment technologies considered in this section.

Wastewater treatment systems are composed of unit operations in which the application of physical forces predominate, and unit processes in which removal of pollutants is accomplished primarily by biological or chemical phenomena. Combinations of unit operations and processes have historically provided an extent of treatment known as primary or secondary. Treatment requirements beyond that provided by secondary unit operations have conventionally been termed as "tertiary treatment" or "advanced waste water treatment." Since the extent of treatment inferred by these terms is arbitrary, that treatment required beyond EPA-defined secondary may be determined by establishing the contaminant removals required prior to discharge or land application. The available unit operations and unit processes may then be grouped together on the basis of compatibility and performance criteria to obtain technologically feasible categories of effluent quality.

The conventional objectives of wastewater treatment are removal of 1) biodegradable organics, 2) suspended solids, and 3) nutrients (nitrogen and phosphorus), and 4) destruction of pathogenic organisms by disinfection.

The objectives of secondary treatment have been the removal of biodegradable organics and suspended solids, and disinfection. More stringent standards have recently focused on nutrient removal for control of eutrophication and ultimate oxygen demand.

The results of an investigation concerning effluent quality requirements and available treatment technologies are shown on Exhibit 4.9g. The available treatment technologies are applied to five major wastewater treatment systems to obtain up-graded effluent standards. The five major wastewater treatment systems considered are (a) activated sludge, (b) fixed film, (c) lagoons and ponds, (d) land application, and (e) physical-chemical.

Ten effluent categories have been selected for this study. Except for EPA-defined secondary treatment, the effluent categories selected primarily represent typical effluent characteristics obtainable from alternative combinations of wastewater treatment processes (i.e. categories are based on technological break points, not on effluent quality standards).

Treatment levels have been established by the State of Kentucky River Basin Planning Group. These treatment levels with their effluent characteristics are related to the effluent categories defined for this study as follows:

Treatment Levels	Effluent Characteristics (mg/L) BOD5	NH_3-N	Do	Effluent Categories
T1A	30	20	4	I
T1B	30	20	8	I & IX
T2A	20	15	4	II
T2B	20	15	8	II & IX
T3A	10	15	4	III
T3B	10	15	8	III & IX
T4A	10	4	4	III & VI
T4B	10	4	8	III & VI & IX
T5A	3	4	4	IV & VI
T5B	3	4	8	IV & VI & IX

The extent of unit operations and processes associated with each effluent category is primarily dependent on the basic BOD removal processes available and modifications required to meet upgraded effluent standards. The five basic types of biological removal processes are biological suspended growth, biological fixed film, lagoon options, land application, and physical-chemical treatment. The extent of treatment or number of unit processes required to meet a certain effluent category is also dependent upon the number and type of existing facilities and flow range. In certain instances, the application of alternative wastewater treatment processes has been divided into two basic design flow ranges, less than 1 mgd, and greater than 1 mgd. These design flow ranges have been selected to provide flexibility and sensitivity in projecting the application of alternative technologies.

The series arrangements in Exhibit 4.9g of effluent quality standards and related applicable treatment unit processes does not necessarily imply a continuous series addition of treatment processes to obtain any one or any combination of desired effluent quality. All treatment processes which are individually capable of meeting any given combination of desired effluent quality would supersede the application of repetitive process requirements. For example a treatment process listed in effluent category VIII may also accomplish some or all of the effluent criteria of categories I through VII.

The ten effluent categories may be combined into 6 basic objectives of wastewater treatment according to effluent quality as follows:

Effluent Categories	Effluent Quality Objectives
I,II,III,IV	Carbonaceous BOD_5 and SS removal
V,VI	Nitrification
VII	Nitrogen removal
VIII	Phosphorus removal
IX	Reaeration
X	Disinfection

Effluent Category I represents EPA-defined secondary treatment effluent standards and constitutes minimum treatment requirements. These effluent standards require BOD_5 and suspended solids effluent concentrations not to exceed 30 mg/L. Effluent Categories II, III, IV represent increasingly stringent levels of BOD_5 and suspended solids removal. Effluent Category II includes all standards that permit concentrations of both BOD_5 and suspended solids to within a range of 20 to 30 mg/L. Effluent Categories III and IV include all standards which require both BOD_5 and suspended solids concentrations within a range of 10 to 20 mg/L, and less than 10 mg/L respectively. The applicability of utilizing various unit operations and processes to achieve these effluent standards is discussed later in this chapter.

Effluent Category V, seasonal nitrification to 4 mg/L NH_3-N, represents seasonal ammonia nitrogen oxidation to nitrite and nitrate. The 4 mg/L ammonia nitrogen value is intended to represent the limitations of the least efficient processes likely to be implemented for seasonal nitrification requirements. The process requirements incorporated within new systems will generally produce a better quality of effluent when compared to that available from process requirements applicable to upgrading existing secondary facilities.

Effluent Category VI, continuous nitrification to 4 mg/L NH_3-N, represents continuous oxidation of ammonia nitrogen. This category of effluent quality will generally require process additions to conventional secondary treatment.

Effluent Category VII, nitrogen removal to 2-5 mg/L total nitrogen, represents typical total nitrogen standards when such are established. Nitrogen removal to the stated effluent quality range represents two different systems applications. The lower range represents the minimum effluent concentrations currently feasible with available technologies. The upper range represents the application of ammonia removal processes - breakpoint chlorination and ammonia stripping - to biological secondary treated effluent. Nitrification must be limited in the secondary treatment carbonaceous oxidation process in order to meet the 5 mg/L total nitrogen effluent standard.

A particular note need be referenced to the fixed film nitrogen removal effluent category. Ammonia removal process additions to fixed film biological systems are not conventionally capable of obtaining the required nitrogen removal standards. The two limiting factors are the lack of control of nitrification in warm temperature conditions and the insufficient oxidation of organic nitrogen to ammonia nitrogen in cold temperature operation. Existing or sequential upgrading from secondary treatment, seasonal nitrification, and continuous nitrification are detailed in addition to new process application.

Effluent Category VIII represents phosphorus removal to 1.0 mg/L total phosphorus. The predominant process application for this effluent quality is metal salt addition to secondary or tertiary clarification processes.

Effluent Category IX, comprises reaeration to 5 mg/L DO. The selection of alternative processes available for reaeration will vary according to the type of secondary treatment process and the applicable flow range.

Effluent Category X, disinfection to 200 MPN per 100 ml. (fecal coliform) is intended to represent the EPA secondary treatment requirement.

BOD_5 and Suspended Solids Removal

Effluent Categories I, II, III and IV in Exhibit 4.9g are intended for the removal of BOD_5 and suspended solids. Effluent Category I is EPA-defined secondary treatment to achieve a concentration of 30 mg/L for both BOD_5 and suspended solids. Effluent Category I can normally be achieved by conventional activated sludge, fixed film, lagoons or land application processes.

Effluent Category II can normally be obtained by well operated, conservatively designed activated sludge processes. This category of effluent can also be achieved and exceeded by land application techniques following primary or secondary treatment processes.

Fixed film plants, as well as highly loaded activated sludge processes, will normally require the addition of chemicals to the secondary settling tanks and in some instances additional final settling tank capacity to achieve a concentration of 20 mg/L of both BOD_5 and suspended solids.

Effluent Categories III and IV, with the exception of processes using land application techniques, can only be achieved through the addition of process units to the basic treatment train (activated sludge, fixed film, physical-chemical). For these three treatment trains, the additional process units provide sequentially, as required, some form of filtration, adsorption or chemical treatment.

Physical chemical processes followed by a biological activated sludge process will also achieve both effluent categories.

Ammonia Nitrogen Removal

Effluent Categories V and VI in Exhibit 4.9g are designed for nitrification or ammonia nitrogen removal. The selection of the appropriate processes to achieve nitrification of the wastes depends to a great extent on whether or not nitrification will be required during warm weather periods or throughout the year. This is so because the basic treatment processes, such as activated sludge and fixed film, can be designed or modified to provide the degree of nitrification required during warm weather

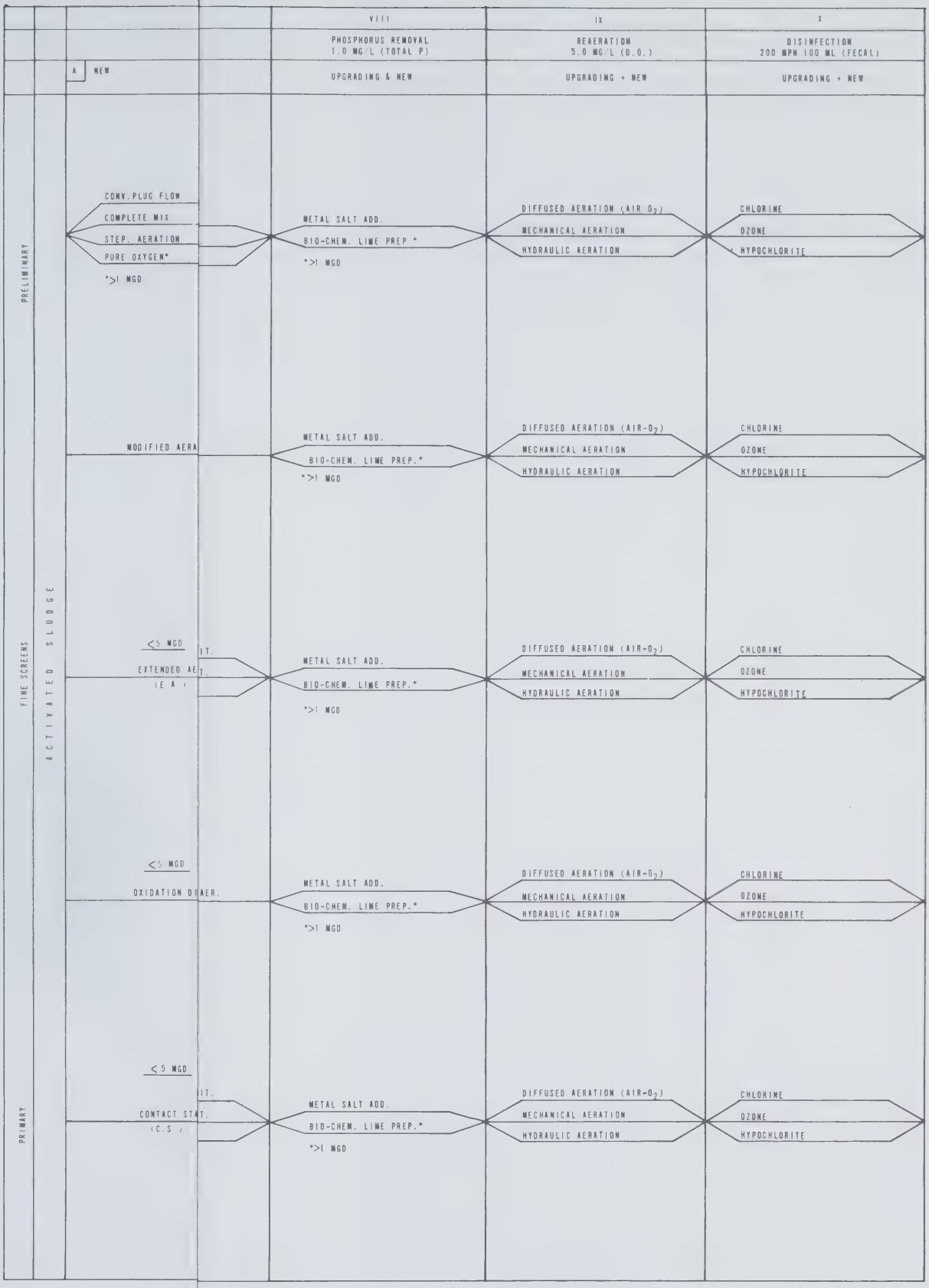


EXHIBIT 4.9g-A
WASTEWATER TREATMENT SYSTEMS FOR ACTIVATED SLUDGE OPTIONS

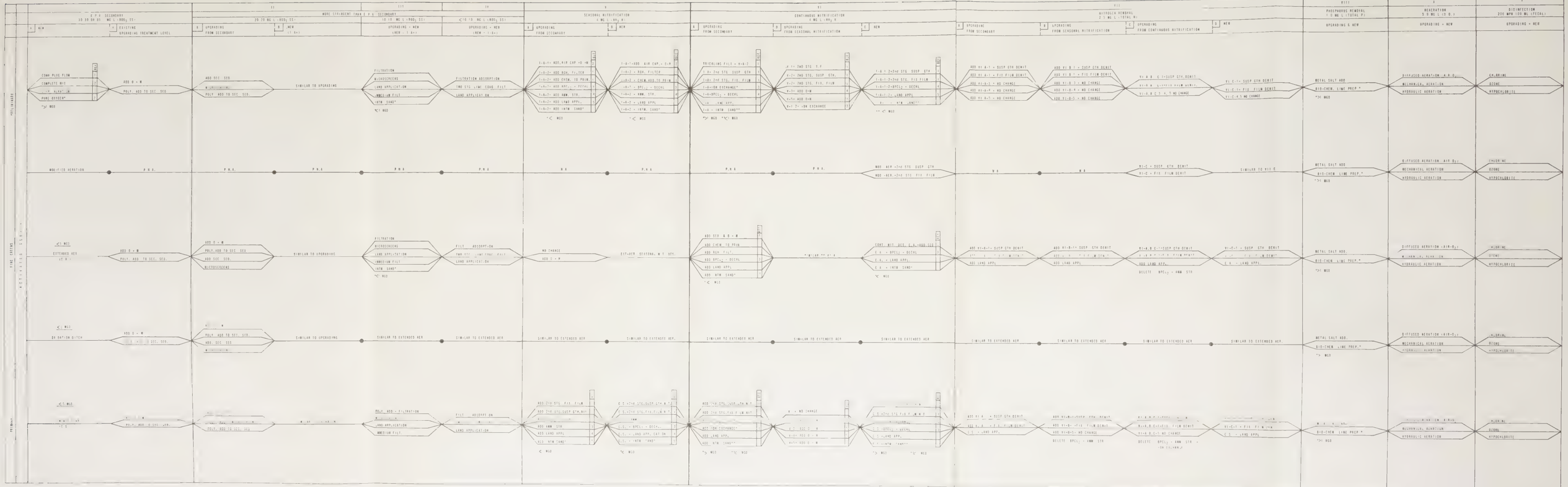


EXHIBIT 4.9g-A
WASTEWATER TREATMENT SYSTEMS
FOR ACTIVATED SLUDGE OPTIONS

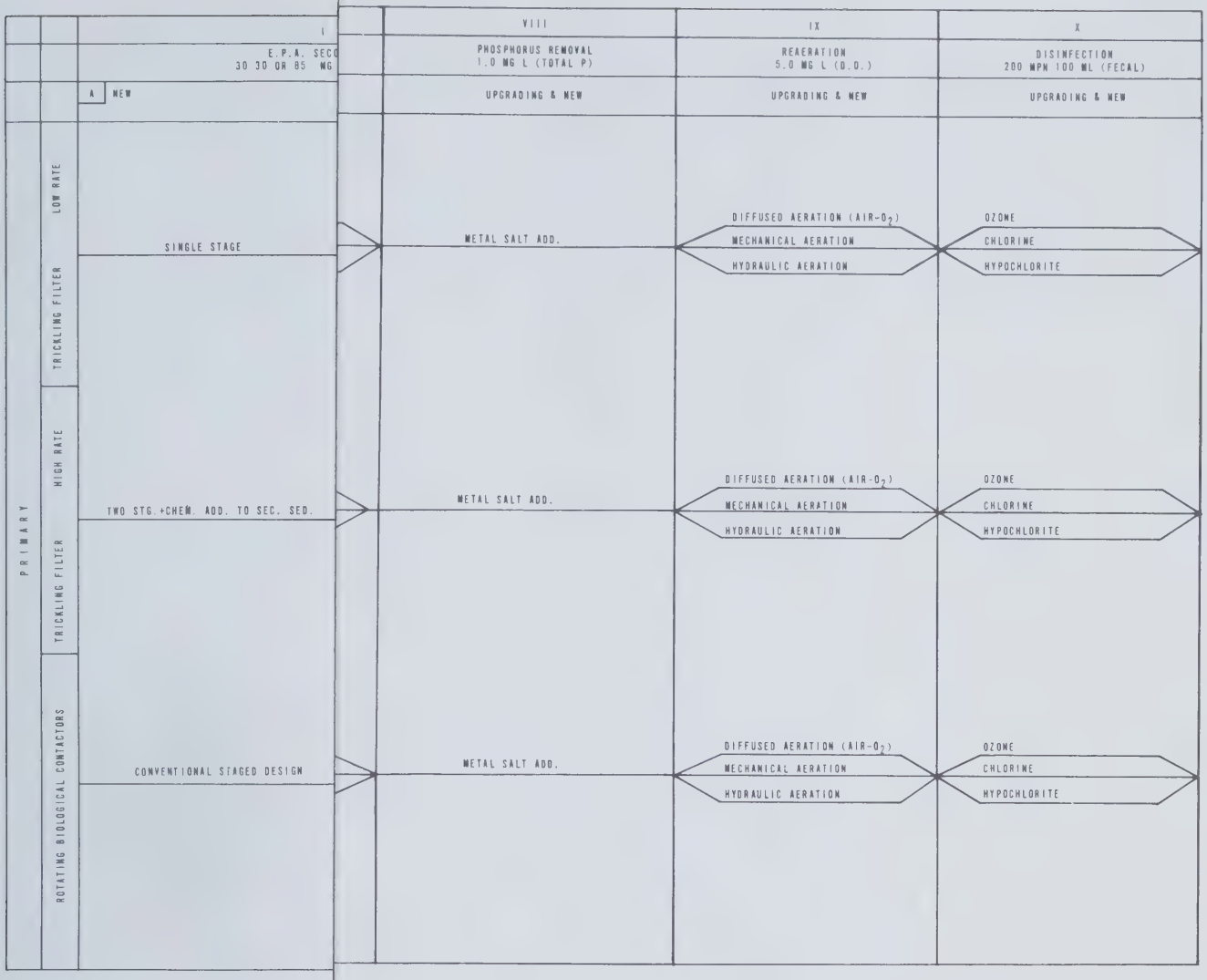


EXHIBIT 4.9g-B
WASTEWATER TREATMENT SYSTEMS FOR FIXED FILM OPTIONS

METCALF & EDDY

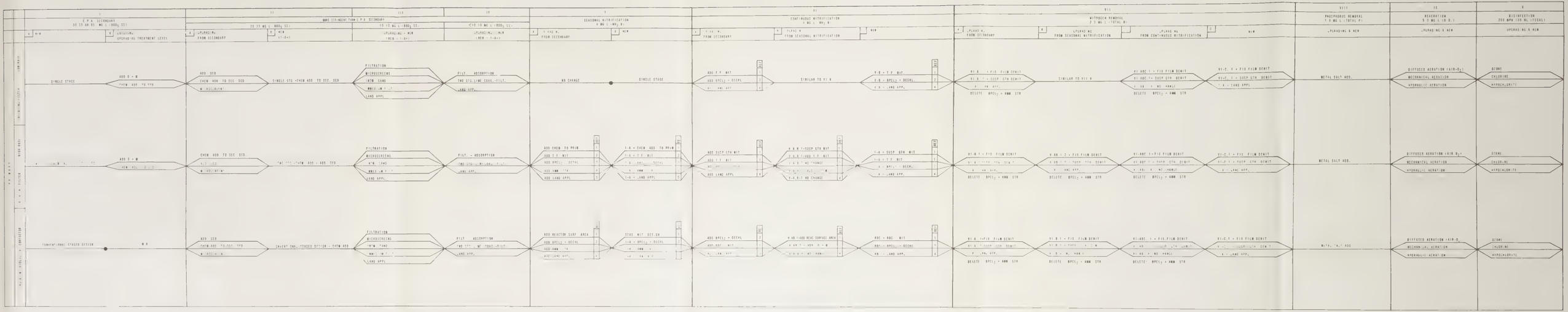


EXHIBIT 4.9g-B
WASTEWATER TREATMENT SYSTEMS
FOR FIXED FILM OPTIONS

METCALF & EDDY

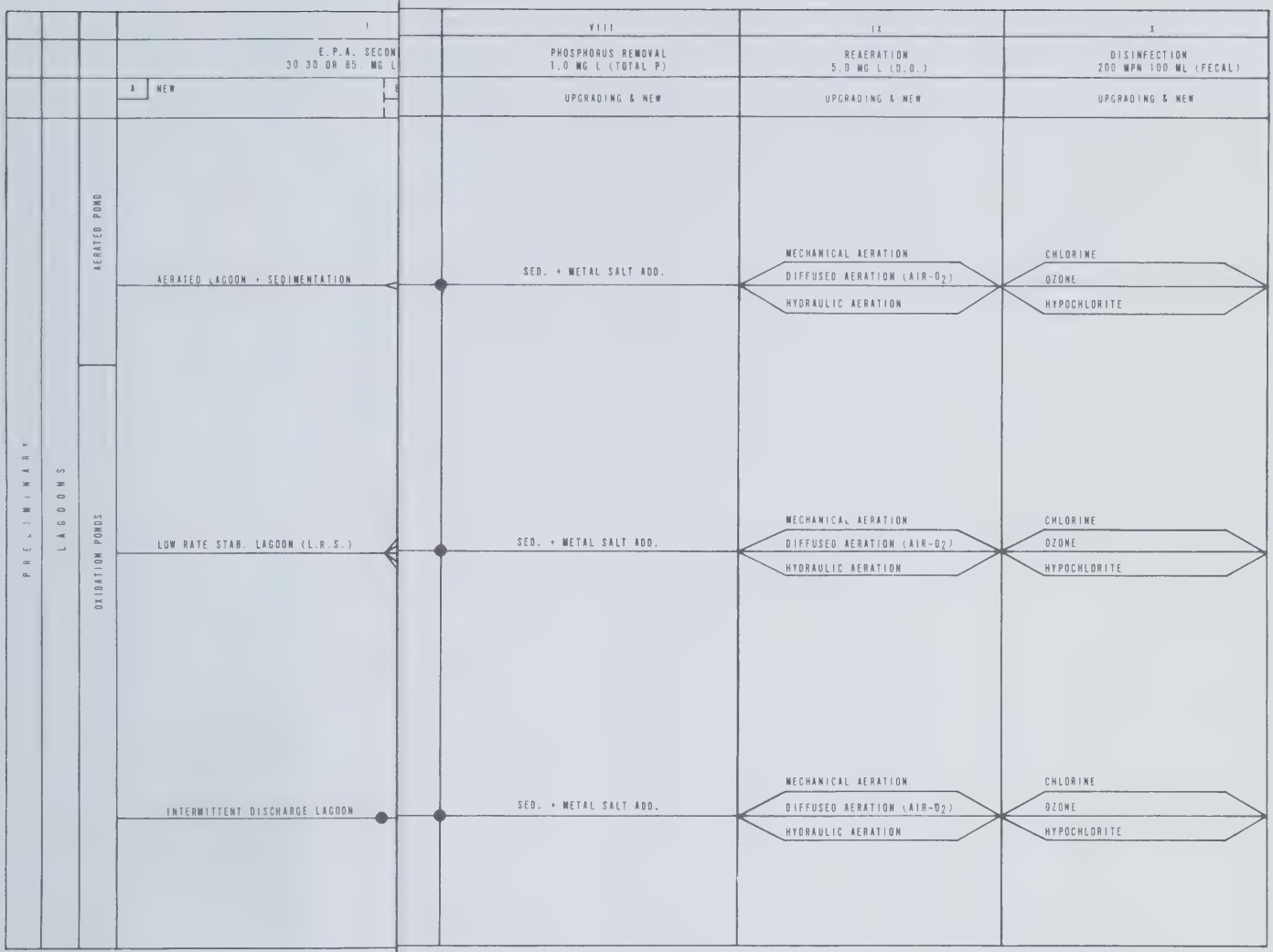


EXHIBIT 4.9g-C
WASTEWATER TREATMENT SYSTEMS FOR LAGOON AND POND OPTIONS

METCALF & EDDY

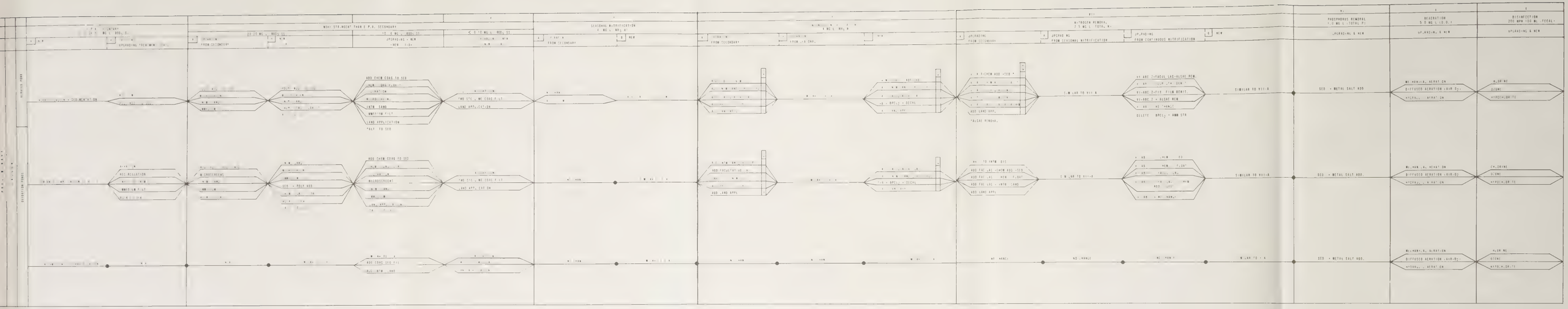
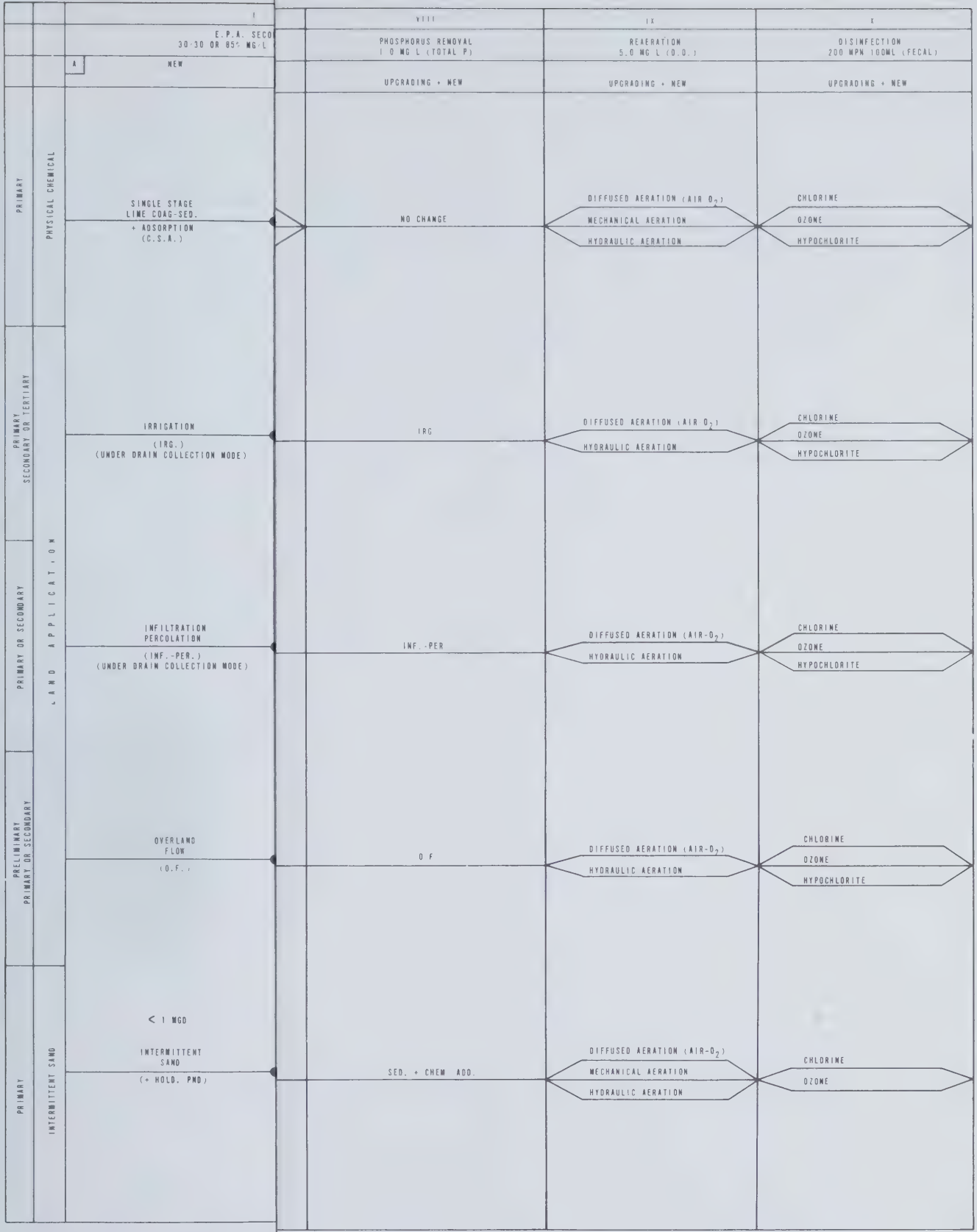


EXHIBIT 4.9g-C
WASTEWATER TREATMENT SYSTEMS
FOR LAGOON AND POND OPTIONS

METCALF & EDDY



*PROCESS APPLICATION TO COLD WEATHER DE
BASED ON pH CONTROL CHEMICAL COST SAVI
PRECIPITATION PROCESS.

EXHIBIT 4.9g-D
WASTEWATER TREATMENT SYSTEMS
FOR PHYSICAL-CHEMICAL AND
LAND APPLICATION OPTIONS

METCALF & EDDY

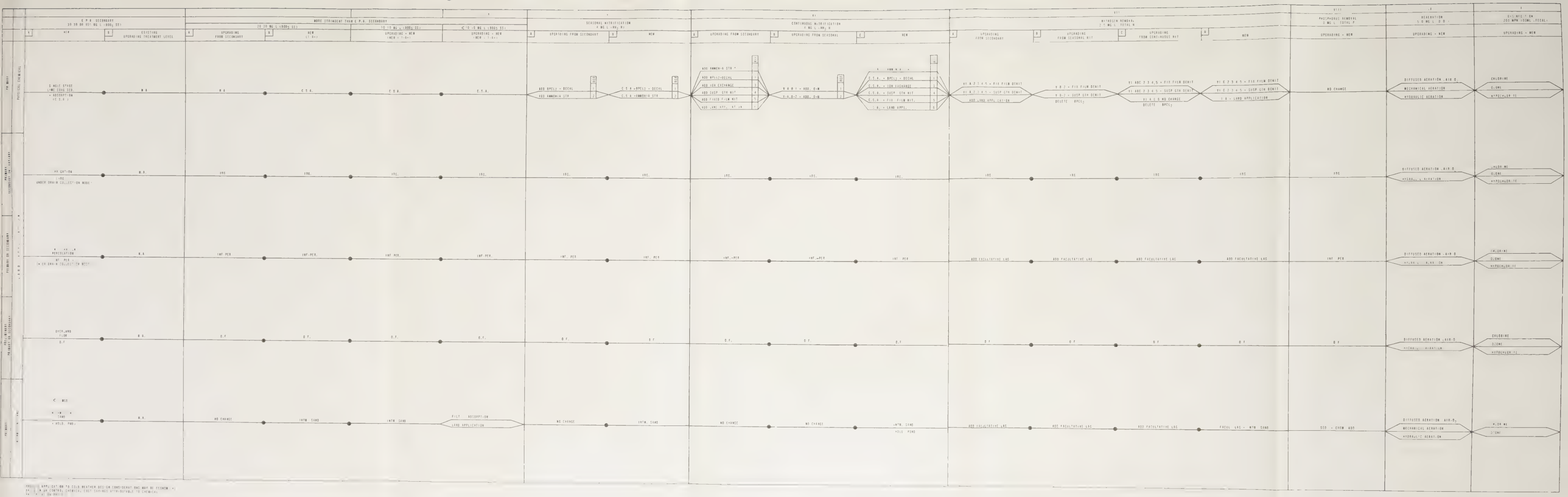


EXHIBIT 4.9g-D
WASTEWATER TREATMENT SYSTEMS
FOR PHYSICAL-CHEMICAL AND
LAND APPLICATION OPTIONS

METCALF & EDDY

conditions. It is for this reason that Exhibit 4.9g has two categories for effluent upgrading, one seasonal and the other for continuous operation.

In a system where continuous nitrification is required, biological suspended growth, fixed film, break point chlorination and ion exchange processes are all applicable. The selection of any particular process must of necessity be job specific, taking into consideration local factors such as overall effluent requirements, local economic and site conditions, and available operational skills.

Nitrogen Removal

Effluent Category VII is designed for nitrogen removal. Nitrogen removal can be required to limit eutrophication problems, and to limit the nitrate content where the receiving waters are used as a source of water supply. Since eutrophication problems are more economically, and normally better controlled through the limitation of phosphorus as a nutrient, nitrogen removal for this purpose is not widely practiced.

The selection of any particular process for the removal of nitrogen, depends to a great extent on the degree of nitrification that can be anticipated in the preceeding process train. This is so, because such processes as ammonia stripping, break point chlorination and the ion exchange require a minimum nitrified influent if they are to operate efficiently. In other cases, the preceeding process may inherently produce an effluent of such chemical composition, that it becomes advantageous to utilize a particular process for nitrogen removal. For example, the physical-chemical process can be easily operated to produce an effluent that will have a proper pH range for the efficient operation of the ammonia stripping process.

Phosphorus Removal

Carbon is a major eutrophic nutrient which occurs in such abundance naturally that it cannot be controlled by man. Phosphorus is a key nutrient in the control of eutrophication which can in part be controlled by man. Although phosphorus sources include runoff, industrial wastes, domestic wastes and animal wastes, the most controllable source of phosphorus in aquatic systems is municipal waste.

The major aquatic systems in which phosphorus creates problems are lakes, reservoirs, impoundments and other such water bodies. In these systems the hydraulic detention periods are great enough to allow for the quiescent conditions necessary for the proliferation of nitrogen-fixing blue-green algae. Normally the creeks, streams and rivers are not quiescent and therefore generally the algae growth is not a problem.

The phosphorus concentration is a typical municipal wastewater is about 10 mg/L. It has been reported that municipal wastes may be reduced by as much as 50 percent by eliminating the use of phosphates in detergents. Reduction of phosphates to minimal levels in municipal wastes may be accomplished by the addition of metal salts (aluminum or iron) and/or lime. The cost of this type of treatment is a factor in overall operating costs of treatment facilities.

Domestic wastewaters contain nitrogen to phosphorus ratios of about 3 to 4 parts of nitrogen to 1 part of phosphorus. Since green and blue-green algae cells normally contain 12 to 15 parts of nitrogen to 1 part of phosphorus, domestic wastewaters contain an excess of phosphorus over that amount that these algae are able to use. This excess quantity can be utilized by certain nitrogen fixing algae in nitrogen deficient waters and this is one of the mechanisms through which excessive algae blooms can occur, resulting in an increase in the nitrogen budget.

All algae, both green and blue-green thrive as long as both nitrogen and phosphorus are present. If nitrogen becomes limiting, certain species of blue-green algae, namely Nostoc, Anabaena, Aphanizomenon and Gleotrichia can still continue to thrive as long as phosphorus is available. This situation develops in lakes and reservoirs but has not been known to exist in rivers, except possibly in backwater areas.

Where phosphorus is present in excess, most algae use nitrogen and phosphorus in a ratio of about 15 to 1 and will flourish up to ratios of 30 to 1. Before phosphorus can become limiting, the phosphorus level must be reduced to less than 0.5 mg/L when total nitrogen equals 15 mg/L or less than 1.0 if it equals 30 mg/L. This criteria for limiting the discharge of phosphorus is only recommended in treatment plants tributary to impoundments and where there is clear evidence of excessive eutrophication. Removal of nitrogen on the basis of controlling eutrophication does not appear warranted.

As a concrete example of corrective action, municipal waste treatment plants which discharge into impoundments may consider including the facilities necessary for the future addition of metal salts. These features can be included during the next alteration or expansion program. The addition of the metal salts may not be necessary until the monitoring program determines that a potential problem exists.

Use of Exhibit 4.9g

To illustrate the use of Exhibit 4.9g, an example of upgrading an existing wastewater treatment system for an activated sludge option is presented.

Assume that a recently built activated sludge treatment plant of the conventional plug-flow design, which is presently operating to meet EPA-defined secondary treatment, needs to be upgraded to meet more stringent effluent requirements. The recently built plant is shown on Exhibit 4.9g-A under category I-A-1, where I indicates category I, A means a new or recently built plant, and 1 means reference 1 which indicates a conventional plug flow design. To simplify the selection process for upgrading, the plant flow is assumed to be greater than 1 mgd. Assume further that the treatment plant needs to be upgraded to achieve an effluent of 10 mg/L BOD_5 and 10 mg/L SS, and is required to achieve seasonal nitrification at present and continuous nitrification in the near future. There is also a possibility that nutrient removal, and reaeration may be required. Disinfection will also be required.

The effluent requirements for BOD_5 and SS indicate that the treatment plant must meet Effluent Category III. Under Effluent Category III, there are four available alternatives to upgrade an existing plant. These are: filtration, microscreens, land application, or immedium filtration. Any of these processes may be used to meet the BOD_5 and SS requirements. Intermittent sand filtration is not considered because the flow is greater than 1 mgd.

A conservatively designed conventional activated sludge treatment plant with proper operation and maintenance will normally achieve seasonal nitrification. Therefore, assuming that the plant is conservatively designed, in Effluent Category V under A - upgrading from secondary, there is only one alternative for the conventional plug-flow design -- that of adding air capacity and improving operation and maintenance. This completes the present treatment requirements. The plant, with seasonal nitrification now appears in Exhibit 4.9g-A at V-A-2, a conventional plug-flow design with added air capacity and improved operation and maintenance. Also, an effluent polishing technique has been added to reduce the effluent BOD_5 and SS each to 10 mg/L.

In the future when it becomes necessary to upgrade the treatment plant to achieve continuous nitrification, three alternatives will be available. In continuous nitrification under Effluent Category VI, under B - upgrading from seasonal nitrification, the three available alternatives following V-2 are: to add a second stage suspended growth nitrification unit, to add a second stage fixed-film nitrification unit, or to add an ion exchange unit. The plant now appears in Exhibit 4.9g-A at VI-B-1 with the addition of either nitirification unit alternatives, or at VI-B-3 with the addition of the ion exchange unit alternative.

If, in addition, nutrient removal (total nitrogen and total phosphorus) is also required, Exhibit 4.9g-A gives alternatives for obtaining these effectively. In Effluent Category VII, under C - upgrading from continuous nitrification, the alternatives are presented for total nitrogen removal. For the treatment plants at VI-B-1 with nitrification units either a suspended growth denitrification unit or a fixed-film denitrification unit could be added. If however the ion exchange unit had been chosen to achieve continuous nitrification, no further treatment would be required, since this process achieves the total nitrogen reduction as required.

If phosphorous removal is also required, effluent Category VIII presents two alternatives for phosphorus removal: metal salt addition to either primary or secondary treatment, or biological-chemical lime precipitation.

If reaeration of the effluent is required, effluent Category IX, presents three alternatives for achieving a minimum D.O. of 5 mg/l. These alternatives are: diffused aeration, mechanical aeration, or hydraulic aeration.

Effluent Category X, disinfection, presents three alternatives for meeting a fecal coliform count of 200 MPN/100 ml. These options are: an addition of chlorine, ozone, or hypochlorite.

Possible Upgrading Alternatives

Exhibit 4.9g is designed to indicate the most feasible technologies that are available to achieve any particular quality of effluent. This technology can be applied in new or upgrading situations.

Historically, many of the urban centers and small communities have provided wastewater treatment plants which incorporated the latest technology available at the time of design. In such cases, the effluent standards set by the regulatory agencies, the ease of operation, and local parameters were used in selecting the design technology. As the available technology has become more sophisticated and as the public has become more aware of the environmental impacts of wastewater pollution, the effluent standards have become more stringent. Accordingly, many of the existing wastewater treatment plants will require upgrading to meet these new standards.

Of particular interest is the technique that will be used in upgrading existing small wastewater treatment plants. This is because in the aggregate, these plants represent a large economic investment and, therefore, should have a capability of expansion and should provide some measure of flexibility and ease of operation.

In the following paragraphs various techniques that can be reasonably applied to upgrade activated sludge, fixed film and lagoon wastewater treatment systems to produce a nitrified effluent low in BOD_5 and suspended solids are presented and discussed.

Activated Sludge

Existing Activated Sludge wastewater treatment plants can be upgraded by using the following techniques:

Unit Process	Alternative			
	1	2	3	4
Continuous Nitirification	Add Suspended Growth	Add Fixed Film	Add Breakpoint Chlorination-Dechlorination	---
Polishing BOD_5 and Suspended Solids Removal	Multi Media Filter	Multi Media Filter	Multi Media Filter	Infiltration Percolation
Reaeration	Mechanical Aeration, Diffused Air, or Cascade	Mechanical Aeration, Diffused Air, or Cascade	Mechanical Aeration, Diffused Air, or Cascade	---
Disinfection	Chlorination	Chlorination	---	---

Under Alternative 3, the multimedia filter process should preceed the breakpoint chlorination-dechlorination process within the treatment train. This procedure will reduce the chlorine demand of the wastewater effluent. The techniques shown above usually apply to plants that have design capacities in excess of 1 mgd. With the exception of Alternative 3, all of the alternatives are adaptable to plants having capacities of less than 1 mgd. Alternative 3 is not readily used in small plants because of the complexity and difficulty of properly controlling the breakpoint chlorination-dechlorination process. The land application technique may be more advantageously and more properly applied to small plants because of the reduced land requirements. Alternative 4 is a land application technique, and as such is applicable only in those situations where the soil characteristics and groundwater hydrology will permit land disposal.

Fixed Film

Single stage high rate fixed film wastewater treatment plants can be upgraded by the following procedures:

Unit Process	Alternative			
	1	2	3	4
Increased BOD_5 & Suspended Solids Removal	Additional High Rate Stage	Additional High Rate Stage	Additional High Rate Stage	Additional High Rate Stage
Continuous Nitrification	Suspended Growth	Fixed Film	Breakpoint Chlorination-Dechlorination	---
Polishing BOD_5 and Suspended Solids Removal	Multi-Media Filter	Multi-Media Filter	Multi-Media Filter	Infiltration-Percolation
Aeration	Mechanical Aeration, Diffused Air, or Cascade	Mechanical Aeration, Diffused Air, or Cascade	Mechanical Aeration, Diffused Air, or Cascade	---
Disinfection	Chlorination	Chlorination	---	---

As in the case of activated sludge plants, the procedures above usually apply to plants larger than 1 mgd in capacity. For reasons previously stated, the breakpoint chlorination-dechlorination technique is usually not applicable to plants of less than 1 mgd in capacity, and the land application technique may be more reasonably adapted for smaller plants. The essence of the proposed treatment trains is providing an additional high rate stage in the fixed film process, to ensure a reduced BOD_5 load in the continuous nitrification process that follows the high rate stage. In some instances, it may be possible to design the continuous nitrification unit to properly nitrify on a year around basis the effluent from the existing single stage high rate fixed film wastewater treatment plant. In such cases, the additional high rate stage process will not be required.

Lagoons

Facultative lagoons in cold weather climates cannot consistantly produce effluents that will meet secondary treatment standards. One mode of operation that can provide a higher quality of effluent is to have sufficient capacity to store wastewater during the winter months and discharge when the wastewater is of proper quality. Since the necessary input data to permit this mode of operation can only be obtained empirically and is site specific, the system does not lend itself to general selection procedures.

Facultative lagoons are normally designed to produce algae for the purposes of oxygen production, and to convert organic and inorganic pollution loads to cellular matter. The discharge of cellular matter that has an oxygen demand can have an adverse effect on the dissolved oxygen content within the receiving stream. One method of overcoming this objection is to aerate the wastewater contents of the lagoon by mechanical means, and to filter the effluent to remove any cellular matter. With the proper choice of design parameters, such a system can produce an effluent that is well nitrified and that has a low BOD_5 and suspended solids content.

DESCRIPTION OF INDIVIDUAL PROCESSES

The unit operations and unit processes that are designated in Exhibit 4.9g are briefly described in the following paragraphs:

Preliminary Treatment

Coventional:

The main objective of preliminary treatment is the removal of coarse solids. This is usually accomplished with bar racks or screens. Comminutors are sometimes used in place of racks or screens to grind up the solids without removing them from the wastewater. Grit chambers are designed to remove grit, consisting of sand, gravel, cinders, or other heavy solid materials that have settling velocities or specific gravities substantially greater than those of the organic putrescible solids in wastewater. Skimming tanks, grease traps, preaeration, and flocculation are additional processes that may be used to make primary treatment more effective.

Fine Screen:

Fine screens, or inclined wedge-wire screens, are static gravity strainers whose function is to remove solids. Fine screens can be used in lieu of conventional preliminary treatment and in some cases for primary treatment.

Primary Treatment

Sedimentation:

Primary sedimentation is used to remove settleable and floating material from wastewater under quiescent conditions. Sludge is collected in a hopper at the bottom of the tank and scum is skimmed from the surface. Chemicals may be added to promote the precipitation of phosphorus compounds, BOD_5 and suspended solids.

Secondary Treatment - Activated Sludge

The activated sludge process uses suspended microorganisms to oxidize, in the presence of molecular oxygen, soluble and colloidal organics contained in domestic wastewaters. During the oxidation process, new cells are synthesized. Some of the synthesized cells undergo auto-oxidation in the aeration tank, the remainder forming excess sludge. Oxygen is required in the process to support the oxidation and synthesis reactions. The solids generated must be separated in a settling tank, with the largest portion returned to the aeration tank, and the excess sludge withdrawn from the system for further handling and disposal. Due to the flexibility of the process an activated sludge plant may have various modifications.

Conventional (Plugflow):

One modification is referred to as the Convetional (Plugflow) process. In this process the return sludge is mized with the incoming wastewater to the aeration tank, and the combined flow passes through the aeration tank with a minimum of mixing (Plugflow). The rate of return sludge usually varies from 15 to 75 percent of the average design flow, with an average rate of return of about 25 percent. The oxygen is normally supplied from an air source, and is dispersed in the aeration tank by mechanical or diffused air techniques.

Design of conventional activated sludge systems is generally based upon application of a volumetric loading rate and a relationship between the incoming organics and the amount of organisms in the system. The volumetric loading generally ranges between 20 and 40 lb. BOD_5/day/1000 $ft.^3$; the ratio of incoming organics to cells in the system (F/M) is generally between 0.2 and 0.4 lb. BOD_5/lb. MLSS/day. At conservative design loading rates this process will also provide seasonal nitrification of wastewater effluent.

The process has certain design and operating limits, and for this reason other modifications have been developed.

Complete-Mix:

In the complete-mix process, influent wastewaters and recycle sludge are uniformly distributed throughout the aeration tank. This flow distribution resulsts in a more uniform oxygen demand throughout the aeration tank when compared to the Conventional (Plugflow) process This permits a greater operational stability when the system is subjected to slug loads. The process can be designed to accept higher volumetric loadings than the Conventional process with little, if any, reduction in efficiency. Volumetric loadings are 30-50 lb. BOD_5/day/1000 ft.^{3}. The F/M ratio is 0.3-0.5 lb. BOD_5/lb. MLSS/day.

Step Aeration:

In a step aeration process, the influent wastewater is introduced at several points along the aeration tank. The return sludge is introduced at the head end of the tank as is the Conventional process. The process can accept higher volumetric loadings than the conventional process, without any reduction in treatment efficiency. Since the incoming flow is distributed along the length of the aeration tank, the initial oxygen demand is reduced below that experienced in the Conventional process. Volumetric loadings are 40-60 lb. BOD_5/day/1000 ft.^{3}. The F/M ratio is 0.2-0.4 lb. BOD_5/lb. MLSS/day.

Pure Oxygen:

The use of pure oxygen rather than air as a source of molecular oxygen, has the advantage of permitting the highest available volumetric loadings of any known process, with a corresponding reduction in aeration tank capacity. The system also has the advantage of maintaining a high dissolved oxygen content in the effluent, and effective odor control. Pure oxygen systems are generally enclosed and operate under a slight pressure in an oxygen rich atmosphere. Volumetric loadings are 150-225 lb. BOD_5/day/1000 ft.^{3}. The F.M ratio is 0.5-0.8 lb. BOD_5/day/1000 ft. ^{3}.

Modified Aeration:

The flow patterns for the incoming wastewaters and the returned sludge are the same as in the Conventional process. Since they are operated at substantially higher volumetric loadings, and F/M ratios, the biological activity is reduced. Aeration requirements and efficiencies are less than those of the conventional system due to this reduced biological activity. The volumetric loading is 75-150 lb. BOD_5/day/1000 ft.^{3}. The F/M ratio is 1.5-5.0 lb. BOD_5/lb. MLSS/day.

Contact Stabilization:

As in the step aeration process this modification involves a change in feed location to the aeration tank. In the process, the return sludge is returned to a reaeration tank, and the incoming wastewater is mixed with the reaerated sludge in a contact tank. Air requirements are similar to those of the conventional process. The process, similar to the step-aeration process, is capable of accepting higher volumetric loadings than the conventional process without reductions in efficiency. Volumetric loading is 40-60 lb. BOD_5/day/1000 $ft.^3$. The F/M ratio is 0.20-0.4 lb. BOD_5/lb. MLSS/day.

Extended Aeration:

The extended aeration process is a complete mix system that is designed to operate in the endogenous phase of the growth curve. This necessitates a relatively low organic loading and long aeration time. For this reason, the process is generally applicable only to small wastewater treatment plants of less than 1 mgd. capacity. Volumetric loading is 10-15 lb. BOD_5/day/1000 $ft.^3$. The F/M ratio is 0.03-0.10 lb. BOD_5/lb. MLSS/day.

Oxidation Ditch:

The oxidation ditch process is an extended aeration process that can be designed to operate on an intermittent or continuous basis. Oxygen for the process is supplied from an air source by means of a series of hydraulically operated motors. Due to the allowable loadings, the process is applicable only to small treatment plants. Volummetric loading is 10-15 lb. BOD_5/day/1000 $ft.^3$ and the F/M ratio is 0.03-0.10 lb. BOD_5/lb. MLSS/day.

Secondary Treatment-Fixed Film

Trickling Filters Low Rate:

A trickling filter is a biological reactor which provides surface area upon which microorganisms can grow. Wastewater is applied intermittently to the top of a bed of coarse stone or synthetic media. While percolating through the filter, the wastewater flows over the microbial film and the soluble organics are readily metabolized and the colloidal organics adsorbed onto the surface. The wastewater is collected at the bottom of the filter in an underdrain system and conveyed to a settling tank where excess biological growth is separated from the liquid effluent.

When used for conventional secondary treatment, low-rate trickling filters are designed for hydraulic loadings of 1-4 mgd/acre, and organic loadings of 5-20 pounds of BOD_5/day/1000 $ft.^3$. Depending on the climate, conservate design loading rates may provide nitrification of the wastewater effluent.

Trickling Filters High Rate:

The biological process invloved is the same for the low-rate trickling filters. High-rate trickling filters used for conventional secondary treatment are designed for hydraulic loadings of 10-40 mgd/acre and organic loadings of 30-60 lb. BOD_5/day/1000 $ft.^3$. In contrast to the low-rate system, the recirculation of filter or clarifier effluent permits both higher and more uniform hydraulic loadings. However, the higher organican loadings do not permit nitrification to occur as readily as in low-rate systems.

Rotating Biological Contactors:

Rotating Biological Contactors (RBC's) consist of a series of closely spaced circular discs of polyvinylchloride, 40 percent submerged in a vat of wastewater, and rotated slowly through the waste. Biological growths become attached to the surface of the discs and eventually form a slime layer over the entire surface area of the discs. The rotation of the discs alternately contacts the biomass with the organic material in the wastewater and then with the atmosphere for adsorption of oxygen. The disc rotation effects oxygen transfer and maintains the biomass in an aerobic condition. The rotation is the mechanism for removing excess solids from the discs by the shearing forces it creates, and also the means of maintaing the sloughed solids in suspension so they can be carried from the unit to a clarifier. In addition to their use for secondary treatment, RBC's can also be operated to accomplish seasonal and continuous nitrification.

Secondary Treatment-Lagoon

Aerated:

An aerated lagoon is a basin in whch wastewater is treated on a flow-through basin. Oxygen is usually supplied by means of surface aerators or diffused aeration units. The action of the aerators and that of the rising air bubbles from the diffuser is used to keep the contents of the basin in suspension. In effect the essential function of this type of lagoon is waste conversion. In a completely mixed lagoon neither the incoming solids nor the biological solids produced settle out. Depending on the detention time, the effluent will contain about one-third to one-half the value of the incoming BOD_5 in the form of cell tissue. Before the effluent can be discharged, however, the solids must be removed by settling.

Low-Rate Stabilization:

A stabilization lagoon is a body of water contained in an earthen basin of controlled shape, which is designed for the purpose of treating wastewater. These ponds are also called oxidation ponds. Three zones exist in these ponds: (1) a surface zone where aerobic bacteria and algae exist in a symbiotic relationship, (2) an anaerobic bottom zone in which accumulated solids are actively decomposed by anaerobic bacteria, and (3) an intermediate zone that is partly aerobic and partly anaerobic, in which the decompisition of organic wastes is carried out by faculative bacteria. In these ponds, the suspended solids in the wastewater are allowed to settle to the bottom. The maintenance of the aerobic zone serves to minimize odor problems, because many of the liquid and gaseous anaerobic decomposition products, carried to the surface by mixing currents, are utilized by the aerobic organisms. Stabilization lagoons, also called facultative lagoons, have been used to provide seasonal and continuous nitrification of wastewater.

Intermittent Discharge:

Facultative lagoons are usually used and operated in series. Sufficient capacity is planned so that all the wastes can be held in the lagoon for a period of six months to one year. During the spring and/or fall period, and after the lagoon contents have stabilized, the final cell in the series arrangement is isolated from the preceding cells. This insures no subsequent short circuiting of any raw sewage for this period of time. The level of dissolved oxygen is measured n the final cell and in the stream along with the volume of flow in the stream. When all conditions are considered correct, the effluent line to the receiving water is opened and the contents of the final cell are discharged over a period of two weeks to one month. Intermittent discharge lagoons can be used to meet secondary effluent standards.

Secondary Treatment-Filtration

Intermittent Sand:

Intermittent sand filtration is a process in which wastewater is intermittently applied to a sand filter. After passing through the filter media, the effluent is collected in an underdrain system. Periodically, the filter media will become clogged with trapped particles. At this time the top surface of the filter is raked and/or replaced, and the cycle repeated. Intermittent sand filters require considerable land area and are therefore primarily used in rural areas where land is cheap. Intermittent sand filtration can also be used as apolishing process to upgrade existing wastewater treatment facilities.

Secondary Treatment-Physical-Chemical

Independent Two-Stage Lime Coagulation:

In the physical-chemical treatment process, lime is added to the raw wastewater in two stages to reduce the level of suspended organic solids and soluable phosphates. In the first stage sufficient lime is added to raise the pH over 11 to remove the phosphorus as a calcium phosphate precipitate and to form calcium carbonate as a coagulant for suspended solids removal. In the second stage gaseous carbon dioxide is added to lower the pH to approximately 10 in order to remove the excess soluble calcium as a calcium carbonate precipitate. The quantity of lime to be added is largely a function of the raw wastewater alkalinity and generally will fall in range of 300 to 400 mg/L of CaO for two-stage lime treatment. A large protion of this lime can be obtained from recovering the calcium in the sludge from the two clarifiers. The sludge is transported to a thermal regeneration facility where the calcium carbonate is decomposed to lime. The carbon dioxide from this thermal process, or another source of stack gases, can be used as the source of CO_2 in the second stage precipitation of calcium carbonate.

Polishing Techniques

Additional Secondary Sedimentation:

Secondary sedimentation is used to remove settleable and flating material from wastewater under quiescent conditions. Sludge is collected in a hopper at the bottom of the tank and scum is skimmed from the surface. Chemicals may be added to promote the precipitation of phosphorus compounds, BOD_5, and suspended solids. Design of secondary sedimentation tanks is dependent on the type of biological treatment preceding it.

Additional secondary sedimentation is sometimes added to existing facilities to meet a more stringent effluent quality. This is basically accomplished because of the additional detention time and overflow rate provided, which makes a higher recovery of suspended solids possible.

Chemical-Polymer Addition to Secondary Clarifiers:

In certain processes solids may not flocculate and settle well in the secondary clarifier. This problem may become acute in plants that are overloaded. The addition of Al or Fe salts will cause the precipitation of metallic hydroxides and/or phosphates. Al and Fe salts, along with certain organic polymers will also destabilize colloidal particles. The resultant destabilized colloids and precipitates will settle readily in the secondary clarifier, reducing the effluent suspended solids, and effecting phosphorus removal.

Microscreens:

Microscreening is a physical straining process normally used to remove suspended solids from secondary effluents for polishing purposes. The process consists of a variable speed rotating drum mounted horizontally in a tank with two compartments. The influent enters the drum from one end and flows out radially through the filtering media attached to the drum's periphery. Backwashing is accomplished at the top of the drum where pressure jets of strained effluent are sprayed onto the screen to dislodge the accumulated solids. The solids flushed from the screen can be recycled to the head of the plant or conveyed to the sludge handling system.

Multi-Media Filtration:

Filtration is used in wastewater treatment as an intermediate or final polishing step for removal of suspended solids and will produce a small reduction in BOD_5. Additional phosphorus may also be removed if the wastewater is previously treated with alum. Multi-media filter beds have been composed of various combinations of anthracite, sand, garnet, and activated carbon. The process may require precholorination to prevent buildup of biological growths on stationary components of filters. Backwash systems are required and high rate filtration may require a polymer feed system to contain breakthrough.

Immedium Filtration:

Immedium filters are primary used in wastewater treatment as an intermediate or final polishing technique. Immedium filtration is a high rate upflow filtration process by which influent wastewater enters the bottom of the filter and flows upward through the filter bed. Backwashing involves pneumatic agitation of the media followed by washing, which expands the bed about 2 percent. Raw or filtered water can be used for backwashing because the filter is washed in the same direction as the flow.

Granular Carbon Adsorption:

Activated carbon treatment of wastewater is usually used as a final polishing process. Wastewater is passed through a columnar bed of granular activated carbon where certain soluble organics are physically and chemically adsorbed in the micropore structure of the carbon. Usually, there is biological activity within the column which aids in the removal of both soluble and suspended organic material. Filtration of suspended solids can be achieved depending on the design of the carbon column. Backwashing facilities are needed and a regeneration system is required to remove the material adsorbed on the carbon.

Powdered Carbon Adsorption:

Powdered activated carbon can be added to biological treatment effluents as a polishing process. The carbon can be added directly to the secondary clarifier or to a separate contact basin. Soluble organics are removed by both adsorption and biological processes on the carbon surface. Since the carbon is very fine, a coagulant may be needed to aid in the removal of carbon particles, or filtration may be required; a regeneration process has not yet been developed for powdered carbon.

Tertiary Two-Stage Lime Coagulation Filtration:

The two-stage lime coagulation-filtration process, as previously described under secondary treatment, can also be used as a tertiary polishing technique that will appreciably reduce the BOD_5 suspended solids and phosphorus concentration.

Upgrading Lagoons

Recirculation Pumping:

Recirculation pumping to upgrade lagoons involves interpond and intrapond recirculation as opposed to mechanical mixing in the pond area. The effluents from pond cells are mixed with the influents to the cells. In intrapond recirculation, effluent from a single cell is returned to the influent to that cell. In interpond recirculation, effluent from one pond is returned and mixed with influents to another pond. Both methods return active algae cells to the feed area to provide photosynthetic oxygen to satisfy the organic load. Recirculation can affect startification in ponds, and thus gain some benefit ascribed to pond mixing. Pond recirculation is not generally as efficient as are mechanical systems in mixing facultative ponds. The major advantages of recirculation are a decrease in the organic loading and prevention of odors and anaerobic conditions in the feed zone of the ponds. Recirculation is usually accomplished with high-volume, low-head pumps.

Aeration:

Aeration is used in upgrading lagoons to supplement the pond's photosynthetic oxidation capacity in instances where the pond must treat high seasonal BOD_5 loadings, or must operate under winter conditions, or where there is little room for expansion. This supplementation is usually achieved by installing compressed air diffusers or mechanical aerators. In addition to transferring oxygen to the liquid, aeration breaks up the thermal stratification that normally develops in oxidation ponds. The mixing derived from the aeration process tends to maintain aerobic conditions deeper in the pond. Aeration systems also serve to prevent odors usually generated in overloaded ponds.

Rock Filters:

Submerged rock filters have been proposed as a method of upgrading lagoons by reducing the algae which is often present in the final effluent. The filters are constructed of rock sizes greater than 2.54 cm. and less than 12.70 cm. A biological slime layer becomes established on the filter media and as the wastewater flows through the filter horizontally, the suspended solids are adsorbed by the biological growth. During part of each year the biological slime layer will function in an anaerobic environment. Therefore, an aeration facility for the filter effluent will be required. The rate of solids accumulated in the filters is very slow making the effective life of the filter approximately 20-30 years.

Flotation-Clarification:

Flotation-clarification is a means of algae remove used in upgrading lagoons. Separation depends on the formation of fine bubbles that are physically attached to the algae causing them to float to the tank-water surface where they are collected and removed. Chemical coagulation enhances the removal. It is the algae-bubble-chemical matrix that is desired for good flotation, rather than large aggregates of chemically bound algae needed for sedimentation. No mechanical flocculation step is provided in flotation. Two modes are available for the formation of the fine bubbles: dissolved-air flotation and autoflotation. In dissolved-air flotation, a portion of the effluent or influent is pumped to a pressure tank where the liquid is agitated in contact with high-pressure air to supersaturate the liquid. When this pressurized stream is released into the influent, fine air bubbles are formed. These bubbles are then coagulated with the algae cells by the rapid addition of chemicals. The algae-chemical-bubble float is then removed at the surface of the tank. Autoflotation differs only in that no pressurization is required for the formation of the fine bubbles.

Seasonal Nitrification

Roughing Filter:

Roughing filters are fixed film biological systems in which a microorganism population develops on the wetted surfaces of the media. Roughing filters have been used ahead of conventional secondary treatment for reducing unusually high influent BOD_5 concentrations. In the seasonal nitrification application the purpose of the process is to reduce the organic load so that a downstream biological process will dependably nitrify the waste during the summer months.

Conventional Activated Sludge:

The conventional activated sludge process, as previously described under secondary treatment, can be used to provide seasonal nitrification of wastewater effluent at conservative design loading rates.

Low-Rate Trickling Filter:

A conservatively designed low-rate trickling filter process, as previously described under secondary treatment, can provide seasonal nitrification with low organic loadings.

Continuous Nitrification

Chemical Addition to Primary Treatment:

The additional BOD_5/SS removals afforded by chemical additions to primary treatment may solve overloading problems on downstream biological systems, or may allow nitrification - either seasonal or continuous, depending on the biological system designs. High pH primary effuents are amenable to NH_3 removal by ammonia stripping.

Suspended Growth:

In a controlled environment, certain microbial population will convert ammonia to nitrate in the presence of oxygen. Nitrosomonas act on dissolved ammonia to form nitrite, which in turn is converted to nitrate by Nitrobacter. This process is carried out in an activated sludge system downstream from conventional secondary treatment or primary treatment with chemical additions. The oxidation of ammonia to nitrate can be carried out with either air or pure oxygen. Because the microbial conversion causes a drop in pH, provision should be made for lime or caustic addition with low alkalinity wastewaters.

Extended Aeration Activated Sludge:

The extended aeration activated sludge process, as previously described under secondary treatment, can be used to provide seasonal or continuous nitrification of wastewater effluent at conservative design loading rates.

Oxidation Ditch Activated Sludge:

The oxidation ditch activated sludge process, as previously described under secondary treatment, can be used to provide seasonal or continuous nitrification of wastewater effluent at conservative design loading rates.

Second-Stage Trickling Filter:

Second-stage trickling filters have been utilized to obtain seasonal and continuous nitrification. Two trickling filters are operated in series with an intermediate clarifier between them. The first stage filter operates as an ordinary trickling filters and consumes most of the organic loading. When the wastewater reaches the second-stage filter the organic loading is very low and this allows autotrophic nitrifying bacteria to form on the filter media. These bacteria convert the ammonia present in the wastewater to nitrites and nitrates. The well-nitrified effluent reduces the total oxygen demand in the receiving water.

Rotating Biological Contactors:

The rotating biological contactors process, as described under secondary treatment, can also be used if properly designed to provide seasonal or continuous nitrification.

Intermittent Sand Filtration:

The intermittent sand filtration process, as previously described under secondary treatment, can be used to provide seasonal or continuous nitrification.

Facultative Lagoon:

Facultative lagoons have been used to provide seasonal and continuous nitrification of wastewater. For a description of the biological process involved, see Low-Rate Stabilization Lagoons under secondary treatment.

Nitrogen Removal

Breakpoint Chlorination:

When chloride gas is added to wastewater containing nitrogen in the ammonia form, hypochlorous acid reacts with ammonia to produce chloramines. Further addition of chlorine to the breakpoint converts the chloramines to nitrogen gas. The reactions involved are dependent on pH, temperature, contact time, and initial chlorine to ammonia rates. A pH control system is usually necessary. Air may be added to the reaction chamber to aid in mixing and to strip nitrogen trichloride, carbon dioxide, and nitrogen gases from solution. Due to toxicity, dechlorination often accompanies this process.

Ammonia Stripping:

Ammonia stripping involves the conversion of NH_4^+ ions to dissolved NH_3 gas by raising the pH of the wastewater to 10.8-11.5. The ammonia is then removed from soltuion by providing air-water contact in stripping towers or ponds.

Selective Ion Exchange:

Certain natural zeolites will selectively remove ammonia from solution. This process is carried out in columnar reactors of either the gravity or pressure flow type. When a column's removal capacity is echausted, the resin is regenerated.

Suspended Growth Dentrification:

Nitrogen in the form of nitrates can be converted to nitrogen gas by bacterial populations in the absence of oxygen. This process is carried out in a plugflow activated sludge system following any process that converts ammonia and organic nitrogen to nitrate (nitrification). The bacteria obtain energy for growth from the nitrate-nitrogen reaction, but require an external source of carbon for all synthesis, because nitrified effluents are usually low in carbonaceous matter. Methanol is commonly used as a carbon source, but nutrient poor industrial wastes have also been employed. Nitrogen gas formed in the denitrification reaction will hinder mixed liquor settling. Therefore, a nitrogen gas stripping reactor should precede the dentrification clarifier. Polishing of residual methanol-induced BOD_5 is an added benefit of the stripping tank.

Fixed Film Dentrification:

Nitrogen in the form of nitrates can be converted to nitrogen gas by bacterial populations in the absence of oxygen. This process is carried out in a columnar reactor containing stone or synthetic media size, this process may not need to be followed by a clarifier, as in the conventional trickling filter system. Adequate solids wasting occurs through the low level suspended solids carry-over in the effluent. Periodic backwashing and/or air scouring is necessary to prevent solids buildup in the column that can cause excessive head loss. As in the suspended growth dentrification system, an external carbon source is necessary; methanol is commonly used, and nutrient poor industrial wastes are potential carbon sources. Most applications of this process involve the downflow mode (either gravity or pressure), an expanded bed (upflow) technique has been tested.

Phosphorus Removal

Independent Physical-Chemical Two-Stage Lime Coagulation:

The physical-chemical two-stage lime coagulation process, as described under secondary treatment, can be used to obtain phosphorus removal from wastewater effluents.

Chemical Addition to Primary Treatment:

Chemical addition to primary treatment can be used to obtain phosphorus removal from wastewater effluents.

In the chemical addition process, ionic forms of Ca, Fe, or Al are added to raw wastewater. The Fe or Al react with the soluble orthophosphorus to produce a precipitate. When lime is used, both the Ca and OH react with the ortho-P to form an insoluble hydroxyapatite. Organic Phosphorus and Poly-phosphate are removed by more complex reactions and by sorption onto floc particules. The insoluble phosphorus, as well as considerable BOD_5 and suspended solids, are removed from the system as primary sludge. Violent mixing and flocculation are necessary upstream of the primaries. Addition of polymers may be required to aid in settling. A base is sometimes necessary in low alkalinity waters to keep the pH in the 5-7 range with mineral addition. Lime recalcination will lower chemical costs, but is a feasible alternative only for larger plants. Phosphorus removal with lime is limted to about 30 percent because the higher pH levels required for more efficient removal are inhibitory to biological systems. Therefore, recarbonation may be required if high phosphorus removals are to be accomplished in the primaries and followed by biological systems.

Metal Salt Addition to Secondary Treatment:

Metal salts are added to the raw wastewater, activated sludge aeration tank, or to the final clarifier influent channel. With trickling filter systems, the salts are added to the raw wastewater or the filter effluent. Multipoint additions have been successful. Phosphorus is removed from the liquid phase through a combination of precipitation, adsorption, exchange, and agglomeration and it is wasted with the primary and/or secondary sludges. The use of lime or ferrous salts is limited because they produce low phosphorus levels only at high pH's which are not compatible with biological treatment. Improved settling and lower effluent BOD_5 result from chemical addition, particularly if polymers are also added to the final clarifier.

Biological-Chemical:

This process utilizes both biological and chemical removal mechanisms to effect phosphorus removal with considerably reduced chemical usage than that of chemical addition methods. This process is only applicable to treatment plants that use the activated sludge form of secondary treatment.

The system consists of three major process steps; 1) Primary effluent enters the aeration tanks where biological absorption of the dissolved phosphorus in the wastewater is accomplished by the phosphorus deficient micro-organisms present; 2) The return sludge from the final clarifiers is introduced to an anaerobic stripping tank, similar to a gravity thickener, prior to recirculation to the aeration tank. Under anaerobiosis the microorganisms release the absorbed phosphorus to the supernatant and renders the return sludge to the aeration tanks devoid of phosphorus. The return sludge is then available to repeat the cycle; 3) The concentrated supernatant is treated with lime and returned to the primary clarifiers where the chemical sludge settles out with the primary sludge.

Land Disposal

Irrigation:

Irrigation is the most common land application technique and involves the application of primary or secondary effluent to the land for treatment and to aid the growth needs of plants. The wastewater is treated by physical, chemical, and biological means through interaction with the soil and plants. Effluent can be applied to crops or vegetation either by spraying or surface techniques for purposes such as avoidance of surface discharge of nutrients; economic return from use of water and nutrients to produce marketable crops; water conservation; or preservation and enlargement of greenbelts and open space.

Infiltration-Percolation

Infiltration-percolation consists of the application of effluent to the soil by spreading in basins or by spraying. Treatment occurs as the water percolates through the soil matrix. Because application rates are high, porous well-draining sand soils that function as natural filters are required. Infiltration-percolation systems can be designed for groundwater recharge; natural treatment followed by pumped withdrawal or underdrains for recovery; or natural treatment with renovated water moving vertically and laterally in the soil and recharging a surface watercourse.

Overland Flow:

In this method of land application wastewater is sprayed over the upper reaches of sloped terraces and allowed to flow across the vegetated surface to runoff collection ditches. Renovation is accomplished by physical, chemical and biological means

as the wastewater flows in a thin sheet down the relatively impervious slope. It is essentially a biological treatment process with a minimum contact time between bacteria and wastewater required for adequate treatment.

Reaeration

Hydraulic:

Hydraulic aeration or cascade aeration is a post-aeration process which is used to increase the dissolved oxygen content of wastewater effluent. The plant effluent passes over a series of steps or weirs, at the base of which air is entrained and dissolved in an amount which is related primarily to the height of the fall.

Diffused Aeration:

Diffused aeration for reaeration increases the dissolved oxygen content of the effluent stream by bubbling compressed air into it through porous or nonporous media. Nonporous diffusers of the nozzle, orifice, and valve type release larger bubbles than porous diffusers. The design of the blowers is based on the static head of the liquid above the diffusers and at the distribution losses. Plug-flow is desirable as it promtes efficient performance of the diffused air reaeration process. Variations from established plugflow, in some instances, could lower this efficiency.

Mechanical

Mechanical aeration for reaeration increases the dissolved oxygen content of the effluent stream by creating turbulence and constantly changing the air-water interface. The design of mechanical aerators for aeration is based on the power required to produce the needed standard oxygen transfer rate. The actual horsepower required varies with the flow characteristics assumed in the reaeration basin. Complete mixing is usually assumed as it will result in a design which assures adequate oxygen distribution. Mechanical aeration can be accomplished in chlorine contact chambers. This eliminates additional land requirements and the construction of separate reaeration tanks.

Disinfection

Chlorine:

Chlorine is perhaps the most commonly used chemical disinfectant. As it is added to the effluent, readily oxidizable substances and organic matter react with the chlorine, reducing most of it to the chloride ion. After meeting this immediate demand, the chlorine will continue to react with the ammonia to form chloramines. With continued addition of chlorine, essentially all of the chloramines will be oxidized. Continued addition of chlorine will result in a directly proportional increase in the free available chlorine.

Hypochlorite:

Hypochlorite salts have also been added to wastewater effluent for disinfection. Sodium hypochlorite and calcium hypochlorite are the most commonly used. Once the salt dissociates, the reactions that take place are the same as for disinfection with chlorine. The use of hypochlorite salts for disinfection has increased during the past few years as a result of shortages and price escalation of liquid chlorine.

Ozone:

Ozone is used in the disinfection of wastewater effluent. Ozone is applied by mixing ozonized air with the water being treated. Organic matter in water has an ozone demand that must be met before the excess becomes available for germicidal activity. Once this demand has been satisfied, bactericidal action is very rapid. The higher the concentration of ozone the more rapid the disinfection. Ozone does not persist as a residual bactericide, but rapidly breaks down in water to oxygen. Due to lack of residuals there is no certainty of completion of disinfection and there remains the possibility of potential contamination once the initial demand is met. Ozone purification also reduces odor problems.

DISPOSAL OF TREATMENT PLANT RESIDUALS

Wastewater treatment plants that provide for pollutant removals produce a significant quantity of residual material. This residual material or sludge is a semi-liquid waste which is normally processed to convert it to a suitable condition for disposal. Sludge disposal includes collection, transportation and final disposal. The purpose of this section is to set forth the quantity and characteristics of the sludge that will be produced in 1980 by those wastewater treatment plants that serve municipalities, individual public institutions and private housing developments.

The characteristics of sludge vary depending on its origin, the amount of aging that has taken place, and the type of processing to which it has been subjected. Sludge from primary sedimentation tanks is usually grey and slimy and, in most cases, has an extremely offensive odor. Sludge from chemical precepitation tanks is usually black and its odor is objectionable but not as bad as odor from primary sedimentation tanks. Waste - activated sludge generally has a brown flocculent appearance and when in good condition has an inoffensive characteristic odor. Waste - activated sludge has a tendency to become septic rapidly and then has a disagreeable odor of putrefaction. Trickling filter sludge, usually known as humus, is brownish, flocculent, and relatively inoffensive when fresh. It generally undergoes decomposition more slowly than other undigested sludges. Sludge from septic tanks is black and, unless well digested by long storage, is offensive due to the hydrogen sulphide and other gases it gives off. Digested sludge is dark brown or black and when thoroughly digested, it is not offensive.

BASINWIDE MANAGEMENT PLAN

INTRODUCTION

The purpose of this chapter is to outline the Basinwide Management Plan for proposed wastewater controls and for the monitoring and surveillance network for enforcing these controls throughout the Lower Cumberland River Basin. The relationship of this River Basin Plan with other ongoing plans such as 201 Facilities Plans, Soil Conservation Service and Corps of Engineers watershed plans and 208 Areawide Management Plans is discussed. The legal basis for this plan and its enforcement is discussed along with existing land use policies and controls under federal, state, and local statutes.

BASIN PLAN FOR 1980 AND 1995

Exhibit 5.1t lists all of the segments in the LCRB and their priorities along with the calculated Total Maximum Daily Load and Maximum Theoretical Daily Load for each of the Water Quality limited segments for estimated 1980 discharge flows. The Total Maximum Daily Load was calculated for all of the segments having known point source waste discharges. Total Maximum Daily Load, TMDL, is defined as the total oxygen demand (lbs/day BOD) that can be imposed on the receiving streams for a discharge, assuming estimated 1980 flow, and still have that stream meet water quality standards. The segment TMDL is merely the sum of the TMDL for the individual discharges in the segment. Maximum Theoretical Daily Load, MTDL, for a segment is the maximum theoretical oxygen demand (lbs/day BOD) that can be applied to the main stem of the segment, with Q7-10 low flow in the stream, and still have that stream meet water quality standards. This calculation of course is based on a theoretical waste load application to the stream all along the reach in question at a rate proportional to the assimilating capacity of the stream at the infinite number of points making up the reach in question.

Exhibit 5.3 m shows all of the segments in the LCRB geographically and relates them color-coded by high, medium, or low priority to all other segments, statewide. Segment priorities are set by number range as follows:

High Priority - greater than 1000
Medium Priority - 200 to 1000
Low Priority - less than 200

Exhibit 5.2t lists the basinwide treatment needs for all of the significant discharges in the LCRB for projected 1980 and 1995 waste flows. It lists the proposed 1980 and 1995 discharge characteristics (compliance goals) for all these discharges and lists for all the municipalities their discharge priorities, non-conservative waste load allocations (lb/day BOD) and costs in millions of dollars to achieve the 1980 compliance goals. Twenty-one significant discharges (5000 gpd or more) are listed with fourteen of them needing T4B level waste treatment (tertiary treatment) or better to meet water quality standards

Exhibit 5.1t: Waste Load Characteristics of Water Quality Limited Segments (1980)

Segment Number	TMDL lb/day TOD	MTDL lb/day TOD	Segment Priority Number
1	12.14	-	76.94
2	2.00	2.133	2.46
3	1.83	1.489	12.65
4	-	-	12.24
5	-	-	11.08
6	34.69	99.991	333.45
7	28.62	27.574	242.64
8	168.05	381.657	292.77
9	-	-	6.20
10	135.12	-	169.50
11	-	-	3.19
12	-	-	1.45
13	515.24	1610.937	1226.88
14	50.02	427.367	140.82
15	-0-	51.287	.58
16	11.68	29.549	20.82
17	20.02	77.564	13.15
18	-	-	1.72
19	26.69	145.678	370.01
20	25.94	-	267.77
21	-	-	-0-
22	-	-	-0-

Footnotes

MTDL = Maximum Theoretical Daily Load

$$MTDL = 17.2\ KatQ$$

TMDL = Total Maximum Daily Load

$$TMDL = 8.34 \sum_{i}^{m} Q_i TOD_i$$

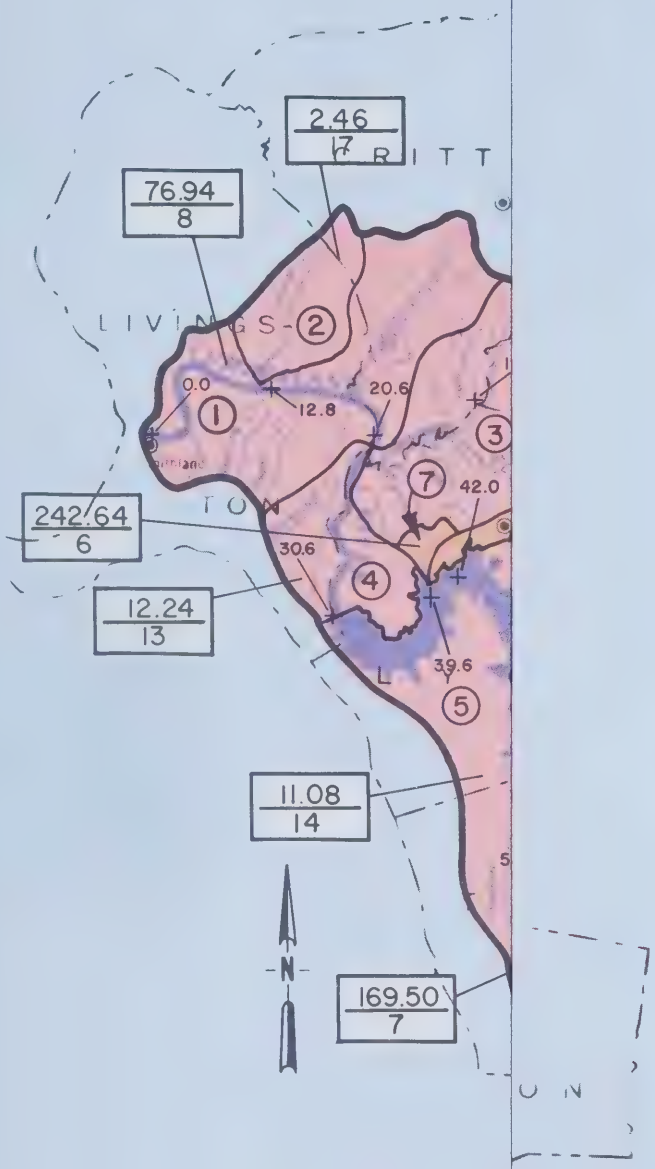
Ka = Reaeration coefficient
Q = Aug. Q through the segment
t = time of travel through the reach
Q_i = 1980 Q for the individual discharge
TOD_i = Theoretical Oxygen Demand

Treatment Level	TOD (mg/1)
T1	135
T2	98
T3	83
T4	20
T5	9

(From Table on page 2 of Memo from Prof. Ed Foree, March 5, 1975.)

Exhibit 5.2t: Basinwide Needs for 1980 and 1995

Discharge Priority	Code Number	Facility	Non-Conservative Waste Load Allocation lb/day	Flow mgd	Compliance Goals 1980 (1995) BOD mg/l	SS mg/l	NH_3 mg/l	DO mg/l	Other mg/l	Treatment Needs 1980 (1995)	Cost Million $
3063.7Aa	02068	Hopkinsville STP	703.73	4.219 (5.684)	10 10	10 10	1.0 1.0	8.0 8.0	-	T4B T4B	37.300
917.6Ca	02071	Elkton STP	27.36	.1643 (.1683)	10 10	10 10	1.0 1.0	8.0 8.0	-	T4B T4B	1.400
695.3Ca	02043	Princeton STP	126.43	.7580 (1.0500)	10 10	10 10	1.0 1.0	8.0 8.0	-	T4B T4B	3.0
644.0Ca	02069	Adairville STP	25.02	.1085 (.1351)	10 10	10 10	1.0 1.0	8.0 8.0	-	T4B T4B	0.289
565.2Ca	02040	Eddyville STP	35.69	.2137 (.2529)	10 10	10 10	1.0 1.0	8.0 8.0	-	T4B T4B	1.9
485.3Ca	02011	Kuttawa STP	3.67	.0489 (.0579)	3 3	3 3	1.0 1.0	8.0 8.0	-	T5B T5B	0.114
287.3Ca	02048	Cadiz STP	- T1B	.1969 (.2069)	30 30	30 30	20.0 20.0	4.0 4.0	-	T1A T1A	1.300
153.9Ca	02001	Smithland STP	1.4	.0380 (.0380)	10 10	10 10	1.0 1.0	8.0 8.0	-	T4B T4B	0.225
59.2Ca	02073	Trenton STP	8.34	.1200 (.1200)	10 10	10 10	1.0 1.0	8.0 8.0	-	T4B T4B	0.060
44.7Aa	02072	Pembroke STP	12.18	.0732 (.0986)	10 10	10 10	1.0 1.0	8.0 8.0	-	T4B T4B	0.438
19.6Ca	02139	Lake City STP	-	.0700 (.1000)	30 30	30 30	20.0 20.0	4.0 4.0	-	T1A T1A	0.174
-	02057	Western State Hospital	10.84	.3000 (.3000)	30 30	30 30	20.0 20.0	4.0 4.0	-	T1A T1A	-
-	02044	ITT Grinnell Corp.	1.16	.0075 (.0075)	-	-	-	-	-	T4B (Industrial)	-
-	02074	Salem Nursing Home	1.0	.0060 (.0060)	30 30	30 30	20.0 20.0	4.0 4.0	-	T1A T1A	-
-	02003	Salem Community	1.0	.0060 (.0060)	30 30	30 30	20.0 20.0	4.0 4.0	-	T1A T1A	-
-	02070	Olmstead School	0.92	.0055 (.0055)	10 10	10 10	1.0 1.0	8.0 8.0	-	T4B T4B	-
-	02076	L. Barkley State Park STP	-	.0800 (.0800)	30 30	30 30	20.0 20.0	4.0 4.0	-	T1A T1A	-
-	02026	L. Barkley State Park STP	-	.0400 (.0400)	30 30	30 30	20.0 20.0	4.0 4.0	-	T1A T1A	-
-	02022	KOA Campgrounds	-	.0080 (.0080)	10 10	10 10	1.0 1.0	8.0 8.0	-	T4B T4B	-
-	02020	Dunbar & Sullivan	-	.0050 (.0050)	10 10	10 10	1.0 1.0	8.0 8.0	-	T4B T4B	-



LOWER CUMBERLAND RIVER BASIN

EXHIBIT 5.3m

BASINWIDE MANAGEMENT PLAN

LEGEND

STATEWIDE PRIORITY RANKING

- HIGH
- MEDIUM
- LOW

11.00 / 2 — PRIORTY NUMBER / RANK IN BASIN

5 0 10 20

GRAPHIC SCALE IN MILES

Base Data: U. S. Geological Survey

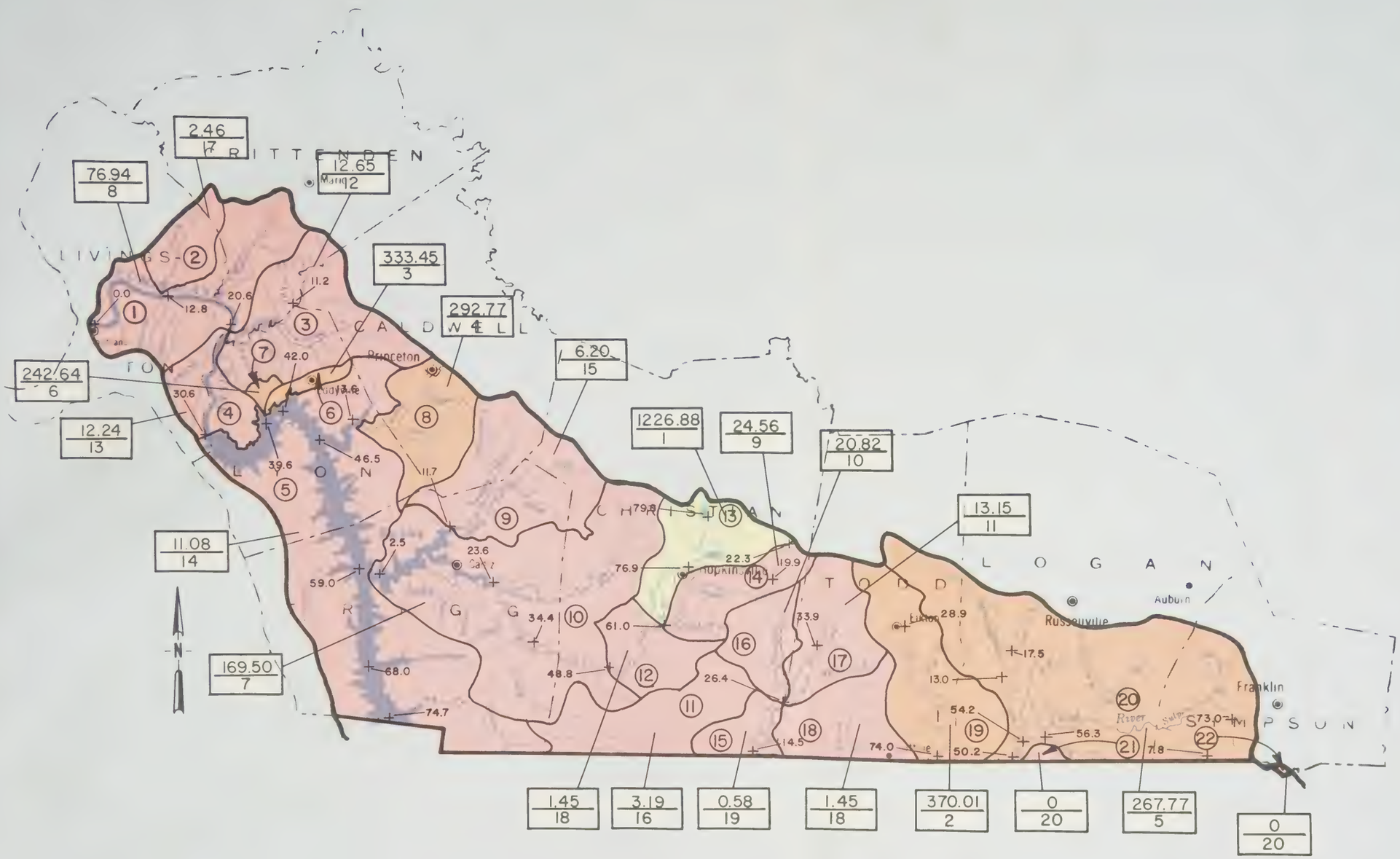
KENTUCKY WATER QUALITY MANAGEMENT PLAN

Prepared for Division of Water Quality

KENTUCKY DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION

G. REYNOLDS WATKINS CONSULTING ENGINEERS, INC.

Lexington, Bowling Green & Louisville, Kentucky



Base Data: U. S. Geological Survey

LOWER CUMBERLAND RIVER BASIN

EXHIBIT 5.3m

BASINWIDE MANAGEMENT PLAN

LEGEND

STATEWIDE PRIORITY RANKING

- HIGH
- MEDIUM
- LOW

1100 / 2 — PRIORTY NUMBER / RANK IN BASIN

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Lexington, Bowling Green & Louisville, Kentucky

in 1980 and 1995.

Recommended Changes in Standards

Required treatment levels of T4B or greater would impose financial hardship on most of the small dischargers. Most of these are not listed in Exhibit 5.2t and have flows less than 5000 gallons per day. Should the T4B or greater treatment levels be required of them and other dischargers who currently have no access to federal or state aid, some type of funding should be made available. In order for most of these small discharges to meet T4B treatment levels, the package plants (most of the small discharges are from package plants) would have to be upgraded at a cost equal to or greater than the cost of the existing facilities and would require much better maintenance and operation thus adding more costs. Should these high treatment levels be enforced for small discharges (i.e. plants of 50,000 gpd or less) for significant effects on water quality of streams then it should be determined by much more extensive monitoring data, the true effect these small discharges have on the Q7-10 zero low flow streams. It should be determined if the cost of treatment yields equivalent benefits and who should pay for this treatment.

Many of the small discharges are schools, hospitals, nursing homes, private homes, etc. where capital financing for treatment plants is not readily available. The receiving streams have Q7-10 low flows equal to zero perhaps should require only secondary treatment for their small discharges since these flows are not great enough to accommodate fish in the streams and perhaps no significant aquatic life.

WATER QUALITY MONITORING AND SURVEILLANCE

Exhibit 5.4t lists the recommended monitoring stations, locations, and the minimum proposed testing frequency for the LCRB as well as those currently being established and utilized by the KDNREP. These proposed and existing stations are necessary to insure that sufficient stream flow and stream water quality background data be gathered. This stream data is necessary for proper implemention and enforcement of the NPDES Permit System.

Previous Records

The bulk of the water quality data utilized for this study was gathered from the U.S. Environmental Protection Agency STORET Data System. The data available from this system for the LCRB was gathered from 1959 to 1975. Most of the data has been gathered from 1970 to 1975 with very little data available from 1963 through 1967.

Water quality data utilized for Lake Barkley has been furnished by the Nashville District Corps of Engineers for the time period from October, 1971 through 1974.

Stream flow data for the LCRB has been furnished by the United States Geological Survey from three guaging stations. Flow data from 1950 to 1972 was furnished for the South Fork Little River at Hopkinsville, 1940 to 1972 for the Little River at Cadiz and 1966 to 1972 for Cumberland River near Grand Rivers.

Proposed Changes To Monitoring and Surveillance Programs

The existing monitoring and surveillance program should incorporate as a minimum the types of tests and their frequencies as shown in Exhibit 5.4t. A significant difference in this monitoring program from the existing program is the requirement for continuous stream flow measurement. The stream flow data is considered as absolutely essential for waste load allocations and treatment level requirements for dischargers.

RELATIONSHIP WITH OTHER PLANS

This section is primarily concerned with the relationship of this River Basin Plan with other federal, state, and local water-related planning in the LCRB. Some of the water and land management plans accomplished or in progress include: 201 Facilities Plans for all "Designated Planning areas" (See Exhibit 5.5m), Corps of Engineers' management and surveillance of Lake Barkley, Soil Conservation Service erosion control and flood retention facilities, county-wide water and sewer plans, Area Development District comprehensive water and sewer plans, and state level water resources plans. The 201 Facilities Planning currently in progress is perhaps deserving of the most consideration by this plan and the required interface between the two. A list of community planning elements completed in the LCRB is included in Appendix "F."

201 Facilities Planning in the LCRB

Current state records show eleven designated 201 Study Areas in the LCRB. These study areas center around the following cities: Cadiz, Eddyville, Elkton, Guthrie, Hopkinsville, Kuttawa, Lake City, Pembroke, Princeton, Salem and Smithland. Only 5 of these areas currently have contracted for their 201 Facilities Planning. These active 201 study areas are Cadiz, Guthrie, Hopkinsville, Princeton, and Salem. Each of the contractors have been contacted for pertiment data in their 201 planning which would affect the River Basin Plan. This data has been utilized to verify treatment requirement levels, stream flows, and alternative waste disposal analysis for several of the municipalities in the LCRB.

Corps of Engineers Management of Lake Barkley

The Nashville District Corps of Engineers controls Lake Barkley and monitors the flow and water quality data of the impoundment. The primary purposes for this impoundment are flood control, hydroelectric power generation, migration and recreation. The Corps water quality data and Lower Cumberland River stream flow data have been very helpful in determining waste water effects in Lake Barkley and waste load allocations for the Lower Cumberland River. The continuing Corps' monitoring of the lake water quality and river flows should be utilized in this continuing River Basin Plan.

Soil Conservation Service Planning

The only records available for SCS study areas in the LCRB are those concerning the North Fork of Little River Watershed Study, prepared February, 1960, by the

Exhibit 5.4t Recommended Monitoring Network - Lower Cumberland River Basin

Station Location - Stream and Mile Point Segment No. ( )	CHARACTERISTICS MONITORED - FREQUENCY*									
	D.O.	NH_3-N	ph	S.S.	Total Phosphorus	Fecal Coliform	Temp.	Stream Flow	BOD_5	Total Hardness
Cumberland R., Below Barkley Dam, M.P.30 (4)	W	W	W	W	W	W	W	C	W	W
Cumberland R. Barkley Lake M.P. 41.5 (5)	W	W	W	W	W	W	W	C	W	W
Cumberland R. Barkley Lake M.P. 58.2 (5)	W	W	W	W	W	W	W	C	W	W
Little River M.P. 74, Hopkinsville WPI (13)	W	W	W	W	W	W	W	C	W	W
Little River M.P. 53.8, Below N&S Forks (12)	W	W	W	W	W	W	W	C	W	W
Whippoorwill Creek, Dot, Kentucky (20)	W	W	W	W	W	W	W	C	W	W
Red River, St. Elmo, Kentucky (15)	W	W	W	W	W	W	W	C	W	W
Elk Fork, Hadensville, Kentucky (19)	W	W	W	W	W	W	W	C	W	W
*Red River, Dot, Kentucky Below S. Fork (8)	W	W	W	W	W	W	W	C	W	W
*Eddy Creek M.P. 13 (8)	W	W	W	W	W	W	W	C	W	W
Cumberland R., Barkley Lake M.P. 70 (5)	W	W	W	W	W	W	W	C	W	W
*Livingston Creek, Above Cumberland R. confluence (3)	W	W	W	W	W	W	W	C	W	W

* C - Continuous
D - Daily
W - Weekly
M - Monthly
Q - Quarterly

Other water quality measurements required for water treatment plant intakes and below industrial or non-point discharges should be taken as shown below.

General Chemical

Acidity	W	Phenolics	W
Alkalinity	W	Total Phosphorus -P	W
COD	W	Potassium	W
Chloride	W	Solids, Dissolved	W
Cyanide	W	Sulfate	W
Fluoride	W	Sulfide	W
Magnesium	W	Solium	W
MBAS	W	Tubidity	W
NO_3-N	W	Silica	W
TKN	W	TOC	W

Trace Elements

Arsenic	W
Barium	M
Cadmium	M
Chromium, Total	M
Chromium, Hex	as needed
Copper	M
Iron	M
Lead	M
Manganese	M
Mercury	M
Nickel	M
Selenium	Q
Silver	M
Zinc	M

Radio Chemical as needed

Pesticides as needed

Biological as needed

Sedimentation as needed

Particle size distribution as needed

LOWER CUMBERLAND RIVER BASIN

EXHIBIT 5.5m

RELATIONSHIP TO OTHER PLANS

LEGEND

201 AREA

- SOLID FOR INTENSIVE (STATE)
- CROSS HATCHED FOR GENERAL (EPA)
- SCS WATERSHED STUDY

5 0 10 20

GRAPHIC SCALE IN MILES

Base Data: U. S. Geological Survey

KENTUCKY WATER QUALITY MANAGEMENT PLAN

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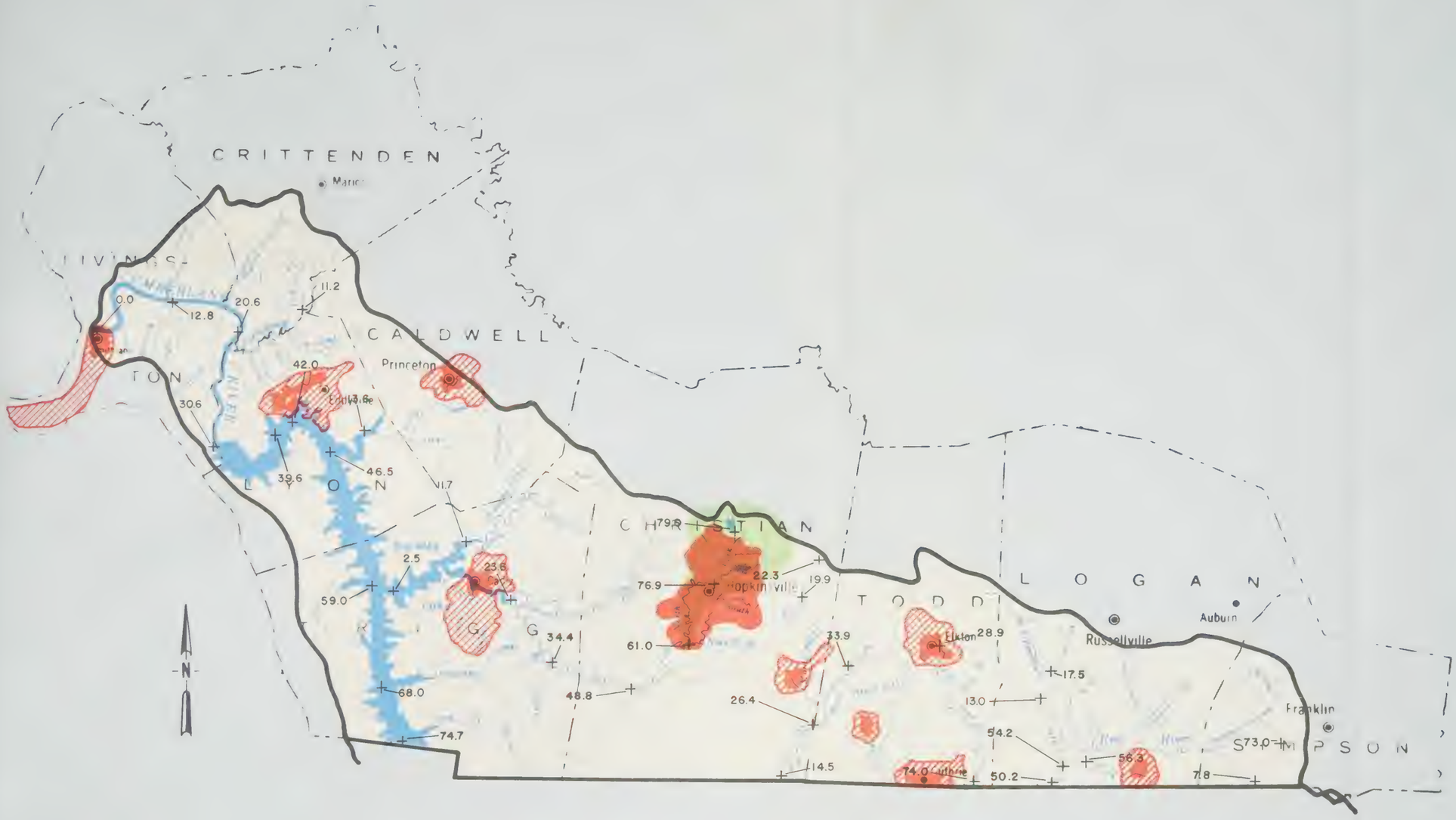

LOWER CUMBERLAND RIVER BASIN

EXHIBIT 5.5m

RELATIONSHIP TO OTHER PLANS

LEGEND

201 AREA

- SOLID FOR INTENSIVE (STATE)
- CROSS HATCHED FOR GENERAL (EPA)
- SCS WATERSHED STUDY

5 0 10 20

GRAPHIC SCALE IN MILES

Base Data: U. S. Geological Survey

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G. REYNOLDS WATKINS CONSULTING ENGINEERS, INC.

Lexington, Bowling Green & Louisville, Kentucky

Christian County Soil Conservation District, the Little River Wasteshed Conservancy District, and the City of Hopkinsville as the sponsoring local organizations. The study was generated because of flood-water damage to crops, pasture, buildings and contents in the Hopkinsville area. This watershed study was investigated for possible low flow augmentation in the North Fork of Little River in order to assimilate greater waste loading of the stream. Data from this watershed study and the 201 planning contractor indicate no available flow augmentation from these reservoirs.

County and Area Development District Water and Sewer Plans

The seven counties which contribute area to the LCRB have all had county water and sewer plans prepared. Data from these county-wide plans, along with more current needs, growth patterns and state and federal requirements were combined in recent years to form comprehensive water and sewer plans for the Pennyrile and Barren River Area Development Districts, portions of which make up the LCRB. Much valuable information for the River Basin Plan was gathered from these A.D.D. plans especially with regard to existing sources of waste water pollution in the LCRB. In some cases existing water quality problems (ground water and surface water) were addressed by these plans along with proposed methods of alleviating the problems. This information was helpful in waste treatment alternatives analysis for the River Basin Plan.

Kentucky Department for Natural Resources and Environmental Protection Water Resources Plans

Several plans generated by the KDNREP were utilized in the accomplishment of this River Basin Plan and they include: The Kentucky Framework Water Plan, 1971; the KDNREP Program Plan, 1974; and the Kentucky Water Quality Report to Congress, 1975.

The Kentucky Framework Water Plan is a comprehensive overview of Kentucky's water resources, their control, quality, uses, and projected needs for them. The plan incorporates the following topics as related to Kentucky's water resources: climate and physiography, economic and demographic growth, water resources management, water supply, water quality, flood control, navigation, power generation, recreation, existing programs, and the Kentucky framework plan of the agencies and departments that are primarily involved with Kentucky's water resources. The River Basin Plan utilizes stream water quality and planning data available in the framework plan for a more comprehensive analysis of the streams in the LCRB.

The KDNREP Program plan was utilized early in the river basin planning stages as a guide to major point sources of pollution.

The Kentucky Water Quality Report to Congress was utilized as a check on tabulated water quality data, watershed slopes and drainage areas in the LCRB.

LEGAL BASIS OF THE PLAN

The primary legal basis for the enforcement of this River Basin Plan lies in the stipulations of P.L. 92-500, wherein secondary treatment levels, best practicable treatment levels, and/or stream water quality standards must be met by waste water dischargers. The stream water quality standards to be met are listed in Appendix C of this report.

Compliance schedules for attaining the minimum treatment levels specified in P.L.92-500 and for meeting in-stream water qualtiy standards have been set in this report for 7/1/77. This compliance date may be modified by the U.S. Environmental Protection Agency, contingent on availability of construction grant funds, cost verses benefits analysis for small dischargers.

LAND USE POLICIES AND CONTROLS

The purpose of this section is to describe official legislative controls available under local, state, and federal statutes for the control of projected growth in the Lower Cumberland River Basin. Between 1970 and 1995, it is projected that the LCRB will gain an additional 39,000 people. To accommodate their needs for housing, schools, roads, businesses, and industry, it is projected that another ten square miles of agricultural land will have to be transformed into urban-type land.

Wherever this new urban-type growth occurs within the cities and counties of the LCRB, it also will add an increased wastewater load to the affected segment basin. And, the ability of a segment basin to absorb future growth will depend on the quality of the receiving streams, the character of the added wastewater load, and the character of the wastewater treatment facility.

Because of these variables, government agencies may prefer to encourage any future growth to occur in those LCRB segment basins which are best equipped to handle the projected wastewater load, and to discourage it within those basins which appear to be unable to accommodate increased loads.

Land use-related measures pertaining to the control of projected growth are quite varied, and exist at the local, regional, state, and federal level. The remainder of this section will discuss "land use controls" in three ways:

- ..Defintion of Land Use - since there is no common definition that is universally accepted, the author will explain what he means by use of the terrain.
- ..Comprehansive Community Planning and land use controls - this will provide background on the broad planning and land use controls pertaining to all aspects of a community.
- ..Water and Sewer planning and controls - this will provide more detailed material on water and sewer planning and controls, since this is the special aspect of the community under study.

A Definition of Land Use

Land use can mean almost anything that man does, or does not do, to use or abuse the land. And, the intensity of the use can vary from little used wilderness land to the muchly abused urban land, with rural and farm land somewhere in between.

Probably few true wilderness areas exist in our Country--places where nature is left almost solely to its own doing, with man seldom being present, even as an observer. Possibly, some of our forest preserves and national parks are as close as we can come to wilderness areas.

Rural and farm land use represents man's next least intensive use of land. Although quantitatively, it is still predominantly characterized by open land and the natural environment, it must be realized that man is attempting to intensively manage the trees, crops, and animals thereon in order to satisfy his fellowman's needs for food, fiber, energy, and building materials.

In the process, this land may be fertilized, eroded, mined, quarried, or otherwise manipulated with effects that may spill over and contribute to the quality of a basin's water supply. Man's buildings and streets are more evident (especially in urban-type subdivisions in rural areas) than in "wilderness areas," but there is still far more open land than urbanized land.

Urbanized land describes man's most intensive use of the land, for it is here that he has constructed most of his buildings and streets in the form of cities--whether small towns of a few hundred people, or large metropolitan areas of several million people.

Buildings and streets are built so closely together that, at times, one is unable to see any remnant of nature on the ground--either a blade of grass or a tree--for everything has been covered with concrete, brick, or asphalt.

Man's urban use of the land for buildings consist of three major types: buildings for residential purposes, for manufacture or production of goods, and for providing goods or services for people. These three basic building types can be further subdivided into successive levels until one establishes a few hundred categories.

What is true for man's buildings also is true for his streets or movement system,--which is simply the use he makes of land in order to move himself or goods, energy, sounds and images, or waste materials from one building or place to another, by means of autos, trains, airplanes, boats, underground pipes, or overhead wires. These also may be divided into a large number of sub-categories.

Comprehensive Community Planning and Land Use Controls

Any comprehensive community planning program must be concerned with the physical, social, and economic aspects of land use at each level of intensity: wilderness, rural, and urban. And, this concern applies to all levels of government, whether local, regional, state, or federal. Activities of each level of government which are pertiment to the LCRB will be discussed in the remainder to this section.

Local Government Activities

Since 1928, cities and counties in Kentucky have had state enabling legislation available to permit them to plan for, and control, their community development. The latest wholesale revision of this legislation occurred in 1966; and as late as 1970, these revisions were recognized as being among the most advanced, innovative, and up-to-date in the nation.

Since 1970, however, a revolution has occurred in relation to "greater citizen interest, concern with the natural environment, and conservation of energy resources." These new interests have made local planning, enabling legislation throughout the country, outdated to a great extent. . . and, to date, the only comprehensive amendments being developed are those in preparation (for the past six years) by a subcommittee of the American Bar Association. Until that, or similar, work is completed and adopted by state governments, the existing enabling legislation must suffice for planning and land use control purposes.

K.R.S.100 - The present Kentucky planning enabling legislation for local governments primarily is contained within Chapter 100 of the Kentucky Revised Statutes. This chapter includes provisions for:

- ..the establishment of cities and/or counties as planning units;
- ..the appointment and duties of a planning commission, including objectives, background research, land use plan, and other elements.
- ..the types of plan implementation or land use control, devices which may be adopted after certain of the comprehensive plan elements have been prepared and adopted. These control measures include a zoning ordinance, land subdivision regulations, capital improvement, programs, and an official map (or public property) ordiance.

LCRB Status - Exhibit 5.6t shows the status of the state enabling legislation.

Planning Commissions - In the "planning commission" column of Exhibit 5.6t, it is indicated that "joint city-county planning commissions" have been established in each of the LCRB counties. The relative activity of these commissions varies, however, with some meeting frequently and regularly, while others meet only on call, or have become inactive. The most active commissions appear to be those within which the greatest amount of past growth has occurred, and future growth will occur--such as the areas in and around Hopkinsville, Princeton, and Cadiz.

Community Plans - Under the three "community plans" column of Exhibit 5.6t, an indication is given as to how many LCRB cities and counties have prepared the three community plan elements cited in the enabling legislation. Again, this indicates that the three major growth areas (Hopkinsville, Princeton, and Cadiz) are the only ones which have prepared and adopted all three community planning elements to guide their future development.

Planning Controls and Implementation - The four columns under this major heading in Exhibit 5.6t indicate the extent to which each city and/or county of the LCRB have backed up their plans with means of implementing them. Surprisingly, more than the three major growth areas have shown progress in adopting these plan implementation, or control, aids. Those with zoning ordinances have devices available for determining what land can be developed in terms of type of use, land coverage, building height, and parking and sign

restrictions.

Those with land subdivision regulations can control how raw land must be developed to include streets, lot lines, parks, school sites, utilities, and other infrastructure items.

Cities and counties with capital improvement programs are able to program for five or six years ahead, in terms of implementing public improvement proposals from their adopted community plans. This should include public facilities such as streets, sidewalks, wastewater collection and treatment, storm water disposal system, gas, water, electricity, parks, schools, and any other public land or building needs. Only Hopkinsville, Cadiz, and Kuttawa appear to be making use of capital improvement programs.

A public property ordinance (or official map ordinance) permits a city or county to reserve land for future acquisition, but within the five-year period of the capital improvement program. For public facilities needed in the future, the "prior reservation" approach can prevent a future street or building site from being preempted, or skyrocketing in price, by private ownership actions. None of the LCRB cities or counties has taken advantage of this potentially useful ordinance, but neither has an other local government in Kentucky.

LCRB Evaluation - It is apparent that a broad range of planning and land use controls are available to the cities and counties in the LCRB. Although improvements are needed in the State enabling legislation, it is presently sufficient to enable cities and counties to manage and guide their future growth.

Although some LCRB cities and counties have taken greater advantage of the enabling legislation than others, there still remains a potential for further improvement by each unit of local government.

Exhibit 5.6t: Status of Community Planning and Land Use Controls in the L.C.R.B.

LCRB Counties and Incorporated Places (and 1970 population)	Planning Comm.	Community Plans			Plan Controls & Implement.				"201" Plan Area	Water Supply System		Sanitary Sewerage System	
		Land Use	Transportation	Comm. Facilities	Zoning Ord.	Sub Regs	Cap. Imp. Prog.	Pub. Prop. Ord.		Exist.	Pro.	Exist.	Pro.
PENNYRILE A.D.D	ADD	X	-	-	NA	NA	NA	NA	303	NA	ADD	NA	ADD
LIVINGSTON CO (7,596)	Joint	X	-	-	X	-	-	-	-	-	-	-	-
-Smithland (514)		-	-	-	-	-	-	-	X	X	X	X	X
-Grand Rivers (438)		X	-	-	X	-	-	-	-	X	X	X	X
-Lake City		-	-	-	-	-	-	-	-	X	X	X	X
-Salem		-	-	-	-	-	-	-	-	X	X	-	X
CRITTENDEN CO (8,493)	Joint	-	-	-	-	-	-	-	-	X	X	-	-
-Dycusburg (89)		-	-	-	-	-	-	-	-	-	-	-	-
LYON CO (13,179)	Joint	X	-	-	X	X	-	-	-	-	-	-	-
-Kuttawa (453)		X	X	-	X	X	X	-	X	X	X	X	X
-Eddyville (1,981)		X	-	-	X	X	-	-	(X)	X	X	X	X
CALDWELL CO (13,179)	Joint	-	-	-	-	-	-	-	-	X	X	-	-
-Princeton (6,292)		X	X	X	X	X	-	-	X	X	X	X	X
-Fredonia (450)		-	-	-	-	-	-	-	-	X	X	-	X
TRIGG CO (8,620)	Joint	-	-	-	-	-	-	-	-	X	X	-	-
-Cadiz		X	X	X	X	X	X	-	X	X	X	X	X
-Ceruleau Sp. (253)		-	-	-	-	-	-	-	-	-	-	-	-
CHRISTIAN CO (56,224)	Joint	X	-	-	X	X	-	-	-	X	X	-	-
-Hopkinsville (21,250)		X	X	X	X	X	X	-	X	X	X	X	X
-Pembroke (634)		-	-	-	X	X	-	-	X	X	X	X	X
-Lafayette (158)									-	-	X	-	X
-Oak Grove									-	X	X	-	X
TODD CO (10,823)	Joint	X	-	-	-	-	-	-	-	X	X	-	-
-Elkton (1,612)		X	-	-	-	-	-	-	X	X	X	X	X
-Allensville (266)		-	-	-	-	-	-	-		-	X	-	-
-Trenton (496)		-	-	-	-	-	-	-	X	X	X	X	X
-Guthrie (1,200)		X	-	-	X	X	-	-	X	X	X	-	X
LOGAN CO (21,793)	Joint	X	-	X	-	-	-	-	-	X	X	-	-
-Adairville (973)		X	-	X	X	X	-	-	X	X	X	X	X
SIMPSON CO	Joint	X	-	X	X	X			-	X	X	-	-

Lexington As Example of Growth Management - To illustrate that the existing Kentucky legislation is capable of permitting a city to do a sound job of guiding and managing its future growth, some aspects of the Lexington, Kentucky planning program will be reviewed.

For seventeen years (since 1958), Lexington's community plans have recommended a policy of channelling all of its new urban growth into the vacant land immediately adjacent to the existing urbanized area, and protecting the remainder of the county (Fayette) for agricultural and non-urban uses. The area encouraged for accepting new growth is called the "urban service area," (about 25% of the county land area) and the remaining 75% of the county is the "agricultural, or rural, service area."

This plan proposal has been implemented by means of the zoning ordinance and land subdivision regulations. Land within the "urban service area" (USA) is zoned for a full range of urban residential, industrial, and commercial uses. The "rural service area," however, is zoned primarily for agricultural acitivities, and the smallest land parcel permitted to contain a house and septic tank is ten acres in size.

During its seventeen year history, attempts have been made to eliminate the "urban service area policy," and many requests have been made to grant urban-type zone changes outside the USA. A few of the zone changes were granted, but most were denied. In fact, an early 1960 court case that challenged the USA concept resulted in the Circuit Court upholding its validity.

In this time, Lexington-Fayette County has added over 60,000 people and twelve square miles of new urban type growth to accommodate its new population, and over 95% of this has occurred within the prescribed "urban service area."

Urban growth management, of the type employed by Lexington, has been of little nationwide interest or concern until a couple of years ago. Since then, an avalanche of cities have established various programs of growth control and management, and several court cases have resulted. Some people feel little more can be done in growth management area until legal issues are clarified that deal with equal protection, due process, taking right to travel, moratoriums, development timing, development impact fees, taxes, land banking and environmental protection.

Regardless of these concerns, Lexington's experience shows that Kentucky cities and counties can move in the direction of growth management under existing state enabling legislation... if they so desire.

Regional Activities

The regional planning agencies in Kentucky are called "area development districts" or "ADD's." These were created in the late 1960's, when an executive order from the Governor grouped the State's 120 counties into fifteen area development districts.

ADD membership is determined by local elected officials within the district, and financing comes from local, state, and federal sources. The two main functions of ADD's are to prepare plans, and to review and coordinate local efforts with state and federal programs. Land use controls, such as zoning and land subdivision regulations, are not included as an ADD function, and remain purely under the jurisdiction of city and county legislative bodies.

The 1973 "Water and Sewer Plan" for seven LCRB counties and their cities was prepared under the direction of the Pennyrile Area Development District, while the Barren River ADD prepared a similar plan for the remaining two LCRB counties. The ADD's also funnel money from the federal government into the cities and counties for long range planning and executive management studies, under the U.S. Department of Housing and Urban Development's "701" program.

State Government Activities

Although Kentucky cities and counties have land use plans and controls, the State of Kentucky has no similar statewide documents. Other states (Hawaii, Vermont, Florida, Oregon) do have plans and controls or established guidelines for State review of such local activities.

Kentucky Council for Land Use Planning - In 1974, however, the Kentucky Legislature enacted a new section of KRS 147, recognizing the need for statewide land use planning. The action was prompted by unsuccessful federal attempts at National Land Use Planning legislation. The Kentucky Act reads, in part, as follows:

> ....in order to protect the natural resources and environment of the Commonwealth, and to insure a water management system that will prevent, and reverse whenever necessary, the deterioration of water quality and provide optimum utilization of our limited water resources, and to facilitate orderly and well planned development and to protect the health, welfare, safety and quality of life of the residents of Kentucky, it is necessary to adequately plan for and guide growth and development within the Commonwealth. In order to accomplish these purposes, it is necessary that the Commonwealth of Kentucky establish land and water management policies to guide and coordinate state, interstate and local decisions relating to growth and development, and that such state land and water management policies should to the maximum possible extent be implemented by local governments through processes for the guidance of growth and development, and that all the existing rights of private property be preserved in accord with the constitution of Kentucky and the United States.

The Act also established a Council for Land Use Planning, composed of 15 members appointed by the Governor and representing a balance of interests in the Commonwealth. The Council is to be the Kentucky agency to fulfill federal requirements for councils, which must exist in order for a State to be eligible for the federal program funds.

By November 1, 1975, the Council is to prepare a report of work that it has undertaken, and any findings, conclusions, recommendations (including the structure of any state land use planning process), and methods for assuring the compatibility of any state land use planning legislation with National Land Use Planning Legislation. In addition, the report is to contain:

(1) Such proposals for changes in legislation as recommended by the Council;

(2) Drafts of model development ordinances which will assist local governments in adoping development ordinances;

(3) Analyses of and comments on other relevant state and national commissioned studies and reports, and reports of public and private agencies;

(4) Review of and recommendations on the current status and effectiveness of local and regional planning agencies with regard to land and water management; and

(5) Such other findings and recommendations as the Council chooses to make.

Environment and Economy - Kentucky has an Economic Development Commission and an Environmental Quality Commission. Each has the responsibility of studying any aspect of its assigned subject, and making recommendations to the appropriate department heads.

The Kentucky Legislative Research Commission has undertaken a Kentucky Environmental Economic Development Policy Project. This project has recommended the establishment of a Kentucky Enviro-Economic Council, to be appointed by the Governor, and would be charged with seeking ways to resolve conflict between economic development and environmental protection. Members would come from business, industry, conservation, education, local and state government, labor, and agriculture.

Federal Government Activities

Federal activities which do, or could, affect land use in the LCRB include proposed National land use legislation, existing grant programs, and regulatory programs.

Proposed National Land Use Bill - The previous session of Congress considered, but did not pass, a land use bill. A similar bill is under consideration at the present time by the House and Senate. Both bills would allocate money to States and local government, over a period of five years, to develop land use plans and policies. The majority of land use decisions would have only local impact and, under the terms of both bills, decision-making on these would remain at the local level. A minor portion of such decisions would require review at higher levels of government.

Generally included in the bills are the following types of considerations:

(1) Designation of a state planning agency with planning staff and authority to compile a data base for planning, develop a land use planning program and coordinate its activities with local, state, and federal planning and pollution control agencies.

(2) Inventories of land and natural resources including projections of land needed and suitable for development to meet economic and social needs.

(3) Development of methodologies to control use and development of land of more than local significance due to its size, environmental impact or potential to induce growth.

Five critical areas and use are generally designated for control in most of the proposed land use bills:

(1) Areas of critical environmental concern, including historical or ecologically fragile lands, land subject to flooding and other natural disasters and regionally significant agricultural and watershed lands;

(2) Key facilities including those public facilities which tend to induce development or urbanization of more than local impact including airports, highway interchanges, recreational areas and energy facilities;

(3) Development of public facilities or utilities of regional benefit--including development of methods to assure that local regulations do not arbitrarily or capriciously exclude development of public facilities, housing or utilities of regional benefit.

(4) Large-scale development - private development such as shopping centers, large subdivisions or apartment complexes which have the potential of creating environmental problems or generating additional development.

(5) Land sales and development projects - large scale development more than 10 miles from a planning unit--second homes, vacation resorts and rural subdivisions.

Federal Grant Programs - Two federal agencies have land use planning grant assistance programs which would be available to LCRB cities and counties. The Department of Housing and Urban Development (HUD), since the early 1960's, has sponsored its "701" program to assist local communities in the preparation of land use plans, controls, and executive management studies. Depending on the size of a city, the grants are processed directly through the HUD regional office, or through the Area Development District. Much of the past long range planning effort by Kentucky cities and counties has come about only through the financial encouragement granted by this federal program.

The Federal Water Pollution Control Act of 1972 led to the U.S. Environmental Protection Agency (EPA), also offering grants to assist in the preparation of land use plans. The main thrust of this act is the development of water quality management plans at the local level (201), regional level (208), and state level (303e). The land use planning is simply a required prerequisite to help in determining future growth possibilities of different areas, and the resulting projected increases in wastewater loads.

Federal Regulatory Programs - The Federal Water Pollution Control Act and the Clean Air Act each have certain aspects that could lead to regulation of local land use. This would be through review, or permit requirements, for any future development that might adversely affect the quality of air or water.

The passage of the National Environmental Policy Act of 1969 required that all federal and federally-related actions, that could have possible major adverse effects on the environment, to prepare on file an Environmental Impact Statement. A National Council on Environmental Quality also was established by the Act. This Council is responsible for preparing guidelines, formulating Impact Statements, and for review and comment on the adequacy of such statements. The

Council cannot disapprove a statement or halt the construction of an affected project. The President, however, does have the authority to halt a project. Sixteen States have similar impact statement requirements, for non-federal projects, but Kentucky is not one of them.

Water and Sewer Facility Planning, Operation, and Financing

The planning, operation, and financing of water and sewer facilities within the LCRB is influenced not only by local actions, but also by those of regional, state, and federal agencies. Some of the agencies which are, or could be, involved are described in this section. Much of this material is excerpted from the 1973 Pennyrile A.D.D "Water and Sewer Plan."

Local Agencies

Planning for the future water and/or sewer facility needs can be undertaken by any of the agencies providing the service. K.R.S. 100 provides enabling legislation for local city, county, or city-county planning commissions to undertake short and long-range planning of this nature, but, in the past, few cities and/or counties have exercised the privilege.

Recent activity in this area has come about, especially in and around cities, only because of new federal legislation, and the E.P.A. "201" program" that helps in implementing the federal legislation. Within the LCRB there are ten areas designated for "201" plans: Hopkinsville, Cadiz, Guthrie, Smithland, Princeton, Adairville, Eddyville, Trenton, Pembroke, and Elkton.

At the local level, water and sewer service may be provided by special districts, municipalities, or private utilities. The existing and proposed water and sewer facilities in the LCRB are shown in Exhibit 5.7m and 5.8m.

Special Districts - There are five special districts enabled by state law to provide water and/or sewer services: Water District, Sanitation District, Joint Metro Sewer District, Sewer Construction District, and Urban Service District. Information on each is provided by Exhibit 5.9t. The powers and duties of these districts are prescribed by statute, and their operations are subject to review by the state agency, or agencies, responsible for the type of service provided.

Water districts, organized under KRS74, are probably the most widely used vehicle for providing water supply facilities in unincorporated areas of Kentucky. Water districts are also enabled to provide sewer and natural gas supply services. Because of statutory restrictions concerning the source of natural gas (limited to within the county in which the district is located) this service is not widespread. However, a water district (KRS74) may supply sewer services in the same manner it supplies water services. Chapter 74 provides three methods of financing improvements for water, sewer, or gas services: (1) special assessments, (2) service charges, or (3) a combination of special assessments and service charges. Additionally, a Chapter 74 water district, able to provide both water and sewer services, is an eligible political subdivision (under various criteria) for interface with federal and state programs to finance improvements and may be merged with other water districts.

Muncipal Utilities - Under KRS96, incorporated cities in Kentucky may provide a variety of utility services and collect special taxes, assessments, and service charges. The KRS citations for these activities are:

Special Taxes and Assessments	KRS 96.910
In-Lieu of Taxes	KRS 96.179
In-Lieu of Taxes (TVA).....	KRS 96.820
Utility Service Charges	KRS 96.170
Gas Service Charges	KRS 96.542
Water and Sewage Service Charges ...	KRS 96.350
Combined Electric and Water Service Charge	KRS 96.171
Sewer Service Charges	KRS 96.910

Municipally owned utility systems may finance capital improvements under a variety of KRS Chapters:

KRS 58 - Acquisition and Development of Public Projects Through Revenue Bonds

KRS 66 - Issuance of Bonds and Control of Funds

KRS 96 - Utilities in Cities

KRS 107- Municipal Improvements: Alternative Methods

Also, if one of these municipalities qualifies under one of the various federal program guidelines, it may receive both federal planning and construction grants and state planning or construction funds. Municipally owned utilities do not fall under the jurisdiction of the state Public Service Commission (PSC) except that the PSC must approve the issuance of debt obligations or acquisition of debt obligations of another utility service (KRS 278.300).

Private Utilities - Private utility companies may provide water, sewer, gas, and electric service in Kentucky under KRS Chapter 278 and other related chapters. Private utility companies finance capital improvements by various financing vehicles, such as sale of stock, debentures, warrants, bonds, and notes. A private utility company may acquire a municipal utility or a nonprofit utility, such as a water district or association, with approval by the PSC.

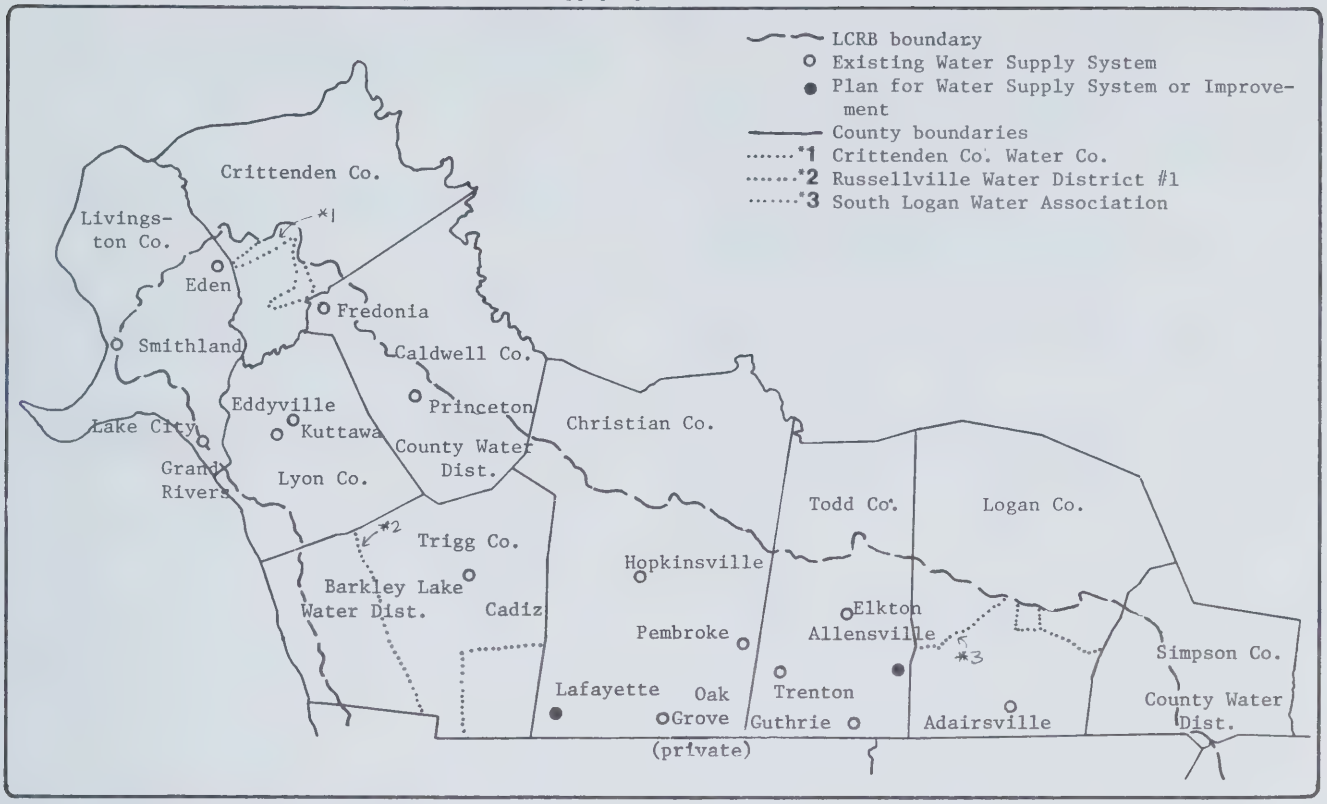
Regional Agencies

The regional agencies closely related to water and sewer planning are the Kentucky Area Development Districts. In the Lower Cumberland River Basin, use was made of the "Water and Sewer Plans" prepared by the Pennyrile Area Development District (PADD) and the Barren River Area Development District (BRADD). The ADD's also have A-95 review and comment responsibilities for federally financed water and sewer projects within their district.

State Agencies

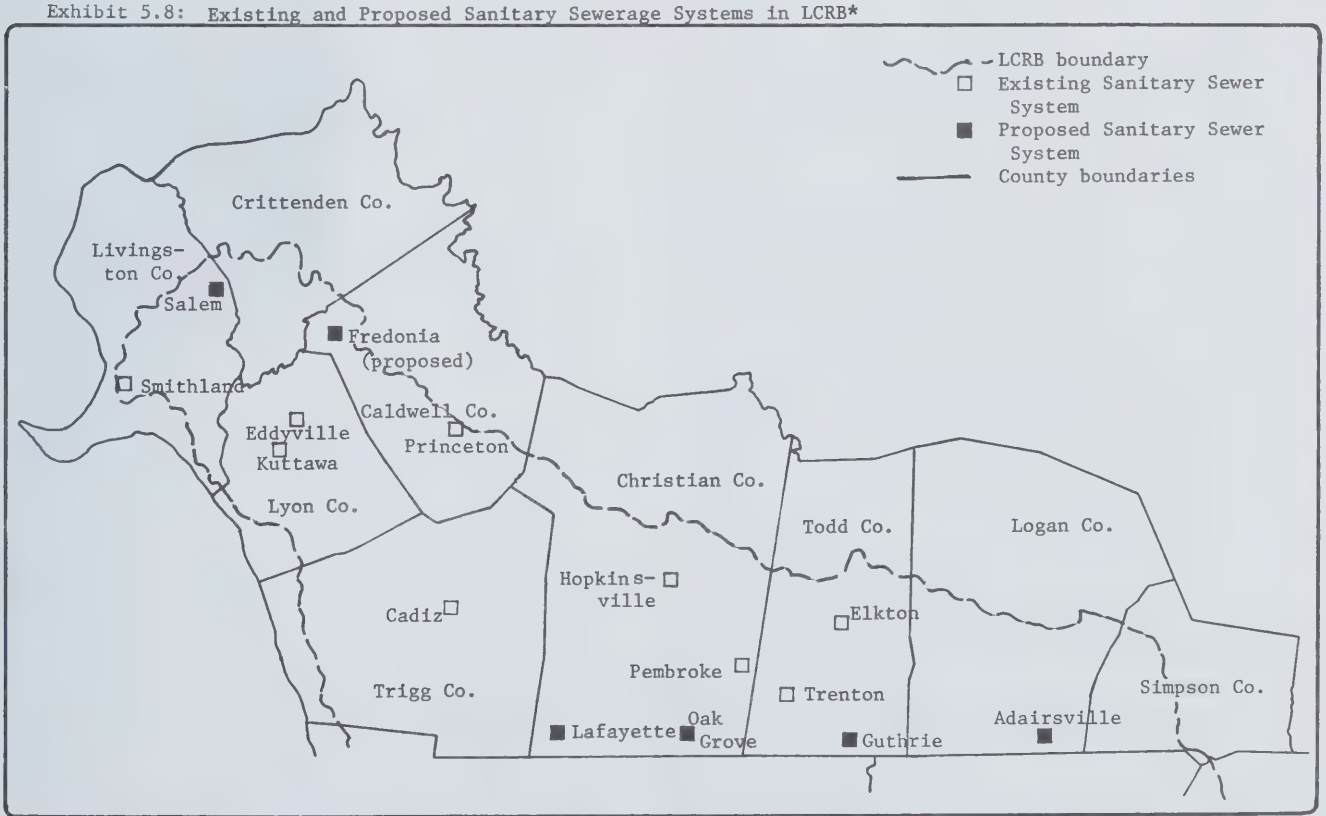
Various state agencies have certain responsibilities for sanitation and pollution control in terms of planning, financing, and/or regulatory control, as cited by various sections of the Kentucky Revised Statutes

Exhibit 5.7m: Existing and Proposed Water Supply Systems in LCRB*



* from Pennyrile ADD "Water and Sewer Plan," 1973, pages 122-124

Exhibit 5.8: Existing and Proposed Sanitary Sewerage Systems in LCRB*



*from Pennyrile ADD "Water and Sewer Plan," 1973, pages 122-24

Exhibit 5.9t: Local Special Districts that May Provide Water and Sewer Service*

	WATER DISTRICT
KRS Citation:	74.010-74.416
Creation:	On petition of 25 freeholders of district. Not less than five resident freeholders shall apply to Kentucky Public Service Commission for approval. District created by county court.
Governing Body:	Board of three to five commissioners, appointed by county judge.
How Financed:	Rates established by commission, and assessments on real estate include within district on classification into five classes according to benefits to be received.
Functions:	Furnish water, gas, or sewage services.
Bonds:	May be issued on authority of ordinance passed by commission for constructing or acquiring additions payable in not exceeding 40 years from date of issue. Bonds may be issued for the amount of unpaid assessments.

	SANITATION DISTRICT
KRS Citation:	220.010-220.504
Creation:	By petition of 60 percent of those in possession claiming as freeholders within proposed district, approved by county board of health to commissioner of sanitation districts.
Governing Body:	Board of directors, number depending upon the number of governmental units in district, appointed by county judge of each county forming a part of the district.
How Financed:	Board may levy one, two, or three annual taxes of not more than 15 cents per $100 of assessed valuation of property within district for organizational expenses. Board shall determine rates and rentals to be charged for sewer service.
Bonds:	May be issued upon resolution by the board of directors. Maximum interest rate shall not exceed 6-1/2 percent and the term shall not be longer than 40 years. Bonds are payable solely from sewer service revenues of the district.

	JOINT METROPOLITAN SEWER DISTRICT
KRS Citation:	76.010-76.230
Creation:	Ordinance passed by legislative body of city of first or second class, approved by mayor and filed with county judge.
Governing Body:	Boad of five members, three appointed by mayor subject to the approval of city legislative body, and two appointed by county judge subject to approval of fiscal court.
How Financed:	Sewer rates, rentals and charges; issuance of negotiable bonds.
Functions:	Rehabilitate, construct, improve and extend any sewer and drainage systems.
Bonds:	May issue revenue bonds secured by revenues of district to mature in not to exceed 40 years. For project within city, issuance of bonds must be authorized by ordinance passed by the legislative body of city.

	SEWER CONSTRUCTION DISTRICT (SUB-DISTRICT OF JOINT METROPOLITAN DISTRICT)
KRS Citation:	76.281-76.420
Creation:	On petition of 25 percent of resident freeholders in district and written statement of metropolitan sewer district filed with county court.
Governing Body:	Commission composed of three members, appointed by county court.
How Financed:	Assessment of property within district on the basis of classification and ratio of benefits to accrue from the contruction. As an alternative, the district may issue revenue bonds payable solely from rentals from operation of systems, and proceed under KRS 107.220, or may use apportionment warrants under KRS 184.150 to 184.250.
Functions:	To provide sewer and/or drainage facilities to serve district.
Bonds:	Bonds may be issued for the amount of unpaid assessments and secured by revenues of the system.

*From Pennyrile ADD "Water and Sewer Plan," 1973, pages 180-182

-From a more detailed discussion of the history, advantages, and disadvantages of special districts, see Research Report No. 48, Legislative Research Commission, 1968.

Exhibit 5.9t: Local Special Districts that May Provide Water and Service (continued)

	URBAN SERVICES DISTRICT
KRS Citation:	108.010-108.070
Creation:	Election held on petition of a number of registered voters equal to 10 percent of the vote cast for county judge in last election.
Governing Body:	District council composed of five elected members with vacancies filled by appointment by Governor.
How Financed:	May collect fees for services and levy assessments in such amounts as council deems necessary to carry out functions.
Functions:	Provide police and fire protection; construct and maintain streets and walks; provide library service, garbage and trash collection and disposal, street lighting and cleaning; acquire, maintain, and operate parks and playgrounds; provide sewer drainage and treatment facilities; and other services.
Bonds:	The Urban Service District is provided with the operating authority provided under KRS 68, 66, and 107 and may issue bonds for capital improvement under those chapters.

(KRS). Some of these agencies include the Kentucky Environmental Quality Commission, the Department for Natural Resources and Environmental Protection and its Division of Water (Quality), the Kentucky Pollution Abatement Authority, the Office of Local Government, and the Public Service Commission.

Kentucky Environmental Quality Commission - This Commission was established by law on January 1, 1973. Its members are charged with examining Kentucky's environmental problems and advising the Governor and the Commissioner of the Department for Natural Resources and Environmental Protection on the basis of their findings.

Division of Water (Quality) of the Department For Natural Resources and Environmental Protection - This division reviews and approves all plans and specifications for wastewater facilities from cities, counties, and private developers--and determines the priority in which the available federal funds are distributed. Advice and assistance in preparing grant applications is given to cities and others. The Division also issues operating permits to municipal, industrial, and private waste treatment facilities. This division is coordinating and guiding the work of producing the Kentucky River Basin's Water Quality Management Plan (303 planning), and also is the State agency for coordination with the federal Environmental Protection Agency.

Department for Finance and Administration - The Department for Finance and Administration is a new cabinet program established by executive order and is responsible for the general administration and finance of state government programs.

The Kentucky Pollution Abatement Authority - is administered by the Department for Finance and Administration. The authority was established by the 1972 General Assembly in response to the Federal Pollution Control Act as a vehicle for financing required state matching funds. The authority is enabled to levy a 2 percent tax on all retail water sales in the state. Additionally, it is empowered to issue "assistance agreements" in the form of loan grants payable from revenues of the local sewer system. Revenue generated by these assistance agreements is then applied as security to amortize revenue bonds issued by the authority, if not otherwise secured by a 2 percent charge on retail water sales.

Office of Local Government in the Department For Finance and Administration - This office acts as the official state planning agency and clearinghouse for various state and federal funds. Those cities, counties, and districts which are eligible to receive federal planning funds may also receive state planning funds as matching funds for federal water-sewer planning grants. This office also provides technical assistance to local governments in qualifying for various federal water-sewer planning and construction grants.

Public Service Commission - The Kentucky Public Service Commission (PSC) is the public utility regulatory agency for the Commonwealth. All private utilities and water districts, associations, and corporations are regulated by this agency.

Under new additions to KRS 74, water districts must have approval from the PSC prior to the provision of services. Also under new additions to Chapter 74 (74, 361), the PSC is authorized and empowered to seek the merger of existing and new water districts, associations, and nonprofit corporations. This authority is based on the principle that a reduction in the number of water districts, associations, and nonprofit corporations. This authority is based on the principle that a reduction in the number of water districts is in the public interest, in that mergers will tend to eliminate wasteful duplications of cost and effort, result in a sounder and more businesslike degree of management, ultimately result in greater economies of scale, and provide, therefore, better service at less cost to the consumer.

The PSC is empowered to initiate such studies and investigations as it deems necessary to make a determination of the advisability of merging two or more water districts. In the event a merger is determined to be viable, the PSC may order such a merger after appropriate public hearings and may establish a schedule of rates, rentals, and charges of the merged district.

This new section of KRS 74 does not limit in any way the acquisition of water districts, associations by private or municipally owned water utilities, or the merger of water districts or associations with private or municipal utilities.

Federal Agencies

Some of the federal agencies involved in water and sewer facilities include the Farmers Home Association, the Environmental Protection Agency, the Department of Housing and Urban Development, and the Economic Development Administration.

Farmers Home Administration (FHA) - This agency provides assistance to incorporated rural communities not exceeding 5,500 population or to rural areas that do not include an incorporated community of more than 5,500. Grants and loans are made to develop or improve water supply and wastewater disposal systems which must primarily serve rural residents, farmers, ranchers, farm, tenants, and farm laborers. Grants are limited to 50 percent of the project cost. To augment this contruction loan/grant program, FHA finances water and sewer planning for rural areas.

Environmental Protection Agency (EPA) - Under the Federal Water Pollution Control Act of 1972, EPA requires three types of water quality plans: basin planning (Section 303(e)); facilities planning (Section 201); and designated areawide waste treatment management planning (Section 208).

Basin plans (303 e) are the water quality management plans for the waters of the State. Together, they provide a Statewide analysis of water quality and waste source problems, and a description of remedial actions. Their primary use is as a management guide for area actions such as grant awards and the identification of needed intensive local planning. Development of basin plans is an integral part of the State water quality planning process.

In contrast with the Statewide character of basin planning, facilities planning under Section 201 of the Act and areawide waste treatment management planning under Section 208 are limited to geographical areas under local jurisdictions. In considering treatment or control requirements, they study the cost effectiveness of alternative waste treatment management techniques and systems. Section 201 planning is directly related to a publicly owned treatment works to be constructed with Federal grant money; Section 208 provides comprehensive planning and regulation in an area having substantial water quality control problems and must result in a wastewater management program covering all points and, if appropriate, non-point sources of pollution in that area.

The need for 201 and 208 planning may be identified through the basin planning analysis, and 201/208 plan objectives must be consistent with objectives established by the plan for the basin in which they are located. Correlatively, basin plans and revisions to basin plans pursuant to the continuing planning process must reflect the objectives and goals of completed 201 and 208 plans.

In addition to the three types of water quality plans, Section 209 directs the Water Resources Council to prepare plans for all regions or river basins in the United States by January 1, 1980. These Level B studies are prepared to address complex long range problems. 208 areawide plans and basin plans should be consistent with complete Level B studies.

Department of Housing and Urban Development (HUD) - Under the Housing and Community Redevelopment Act of 1974, the old "water and sewer categorical grants program" was eliminated (along with several other categorical programs), and replaced by a "community development block grant program." Among other things, this new program permits use of the federal grant for the "construction, reconstruction, and installation of public works, including water and sewer facilities.

Economic Development Administration (EDA) - This agency makes basic and supplementary loans and grants for the construction of public works and development facilities in designated geographic areas where economic growth is lagging behind the rest of the nation. The basic grant is 50 percent of the project cost, but the federal contribution may be increased up to 80 percent in severely depressed areas.

The EDA may provide assistance to water and sewerage facilities under this program, provided: A. the project will directly or indirectly (1) tend to improve the opportunities for the establishment of expansion of industrial or commercial enterprises, (2) otherwise assist in the creation of additional long-term employment opportunities, or (3) primarily benefit the long-range unemployed and members of low-income families or otherwise substantially further objectives of the Economic Opportunity Act of 1964; B. the project will fulfill a pressing need; and C. the area for which a project is to be undertaken has an approved Overall Econoic Development Program (OEDP) and such project is consistent therewith. Applicants for supplementary grants must have applied for all available assistance from FHA, HUD, and EPA and have complied with the criteria established by the basic grant agencies before EDA will consider the application. A qualified Title I county is eligible for 50 percent project assistance.

Summary of Land Use Controls

Although improvements definitely could be made in the governmental policy and land use controls applying to the LCRB, they presently appear to have the potential for guiding and regulating growth in a manner that would help to achieve the objectives of wastewater management.

Existing Kentucky planning enabling legislation (KRS Chapter 100) permits all cities and counties in the State to form planning commissions, prepare community plans, including land use plans, and to adopt plan controls and implementation aids. If put into operation by LSRB local government units, and if used effectively, the planning activities could guide and direct growth into the segment basins best able to accommodate increased wastewater loads.

Although the needed legislation is available, the LCRB governmental units vary in terms of the extent to which they make use of it. For instance, joint city-county planning commissions exist throughout the basin, but some have not held official meetings recently, while others have no regular meeting dates. The degree to which community plans and control devices have been prepared and adopted also varies from very good to poor. In some situations, plans and controls need to be prepared and used for the first time, and, in other cases, the work is in need of updating.

When these local government opportunities are combined with related agencies and programs at regional, state, and federal levels, the potential for proper growth guidance becomes even stronger. Improvements can, and should be made in policy and legislative controls, but they are presently sufficient to achieve the objectives, and comply with the requirements, of Public Law 92-500.

Chapter VI

PUBLIC PARTICIPATION

INTRODUCTION

The Federal Water Pollution Control Act (amended 1972) and subsequent EPA guidelines describe public participation as a key element in the development of River Basin Plans. The growing concern of the public for the environment, and its new willingness to participate, are two reasons for the emphasis on public participation. The very nature of the Act and its broad effect on water quality, land use, and natural resources demands public imput and the development of avenues of communication between the general public and state, local, and private planning agencies.

LEGAL REQUIREMENT

The laws governing public participation in the formulation and adoption of a river basin plan are assembled in the EPA guideline - Part 131 on Preparation of Water Quality Management Basin Plans. Section 502 deals specifically with public participation and requires one or more public hearings before adoption or substantive revision of the proposed basin plan or parts of the plan. Public hearings must be prominently advertised at least 30 days prior to the date of the hearing. Also, each hearing must include total public disclosure, planning agency representation, and sufficient opportunity for expression of views by the public. A record of each meeting must be prepared for submission to the EPA Regional Administrator. Any major controversy raised by the hearing must also be submitted along with the basin plan. The number and location of hearings reflect the size of the planning area, its population, and population distribution. Finally, public participation must be encouraged from the earliest stages of plan development through preparation, revision and adoption.

PUBLIC PARTICIPATION PROCESS

The approach to be followed in each of the Kentucky River Basins for public participation was developed through the joint efforts of a committee of Basin consultants and representatives from the Kentucky Division of Water (Quality) and the Kentucky Environmental Quality Commission. The approach was divided into three levels of acitivity: providing information and education opportunities, securing public involvement, and holding a public hearing. The use made of each level in the Lower Cumberland River Basin is described in the remainder of this chapter.

Information and Education

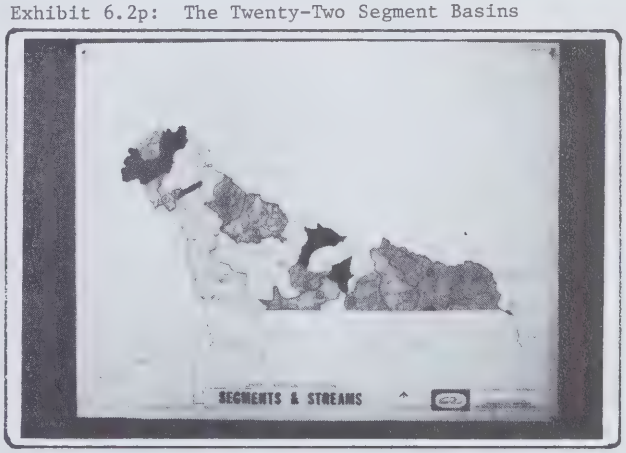
The first level of public participation was directed towards providing LCRB citizens and public officials with information and educational opportunities sufficient to enable them to effectively participate in the planning process. Information materials could include brochures, reports, articles, or interviews disseminated through meetings, newspaper, radio, and television. Some of the materials prepared for the LCRB, and their method of dissemination include the following:

Exhibit Boards - To provide graphic information for visual communication purposes, four exhibit boards were prepared. The first board displayed a map of all the counties within the Pennyrile Area Development District (PADD), as well as the one or more river basins serving each County. The consultants working in each basin also was indicated, as shown by Exhibit 6.1p.

Exhibit 6.1p: Basins and Consultants in P.A.D.D.

The second exhibit board, as shown by Exhibit 6.2p, divides the LCRB into twenty-two segment basins, which represent the smallest geographical areas under study. Counties and streams also were shown on the maps in order to assist persons in establishing general locations.

Exhibit 6.2p: The Twenty-Two Segment Basins



The third exhibit board showed locations within the LCRB where "201 water quality management studies

have been, or will be, placed underway. And, the fourth board used a bar chart, along with county outlines, in order to show existing and projected population figures. These two exhibits, as well as the first two, are shown by Exhibit 6.3p, where two of the GRW Engineers consulting staff members are reviewing the completed work.

Exhibit 6.3p: Review of the Four Exhibit Boards

These exhibit boards were displayed at the Pennyrile ADD Board meeting on 3-5-75; at the 6-13-75 Workshop held at the Environmental Education Center, Land Between the Lakes State Park; at the June public hearing; and at person-to-person meetings with public officials in the LCRB.

Report - An informational report, "Kentucky River Basin Planning for Water Quality Management Within the Pennyrile A.D.D.", was prepared for public distribution at the A.D.D. Board meeting in March. The A.D.D. Executive Director requested, and was given, several additional copies for distribution to Board members not in attendance, or for other interested persons. Copies also were distributed by the consultants in person-to-person meetings within the LCRB.

The report was seven pages in length, and was printed in a format similar to the report at hand. The contents of the report were divided into six sections, which included an introduction; a description of federal law 92-500 and its requirements for water quality planning; the planning process required by the law; background information on the needed plan for the Lower Cumberland; basinwide management needs that would be addressed by the plan; and a proposed outline, or table of contents, for the final report.

Newspaper Articles - Articles prepared by the consultant, with specific basin information, were forwarded to the Public Information Office of the Department for Natural Resources and Environmental Protection. These articles, plus articles originating in that office, were periodically sent to the local news media in the Lower Cumberland River Basin, and were used by the eleven major newspapers in the basin, as well as for radio coverage on Hopkinsville stations.

The consultants also were interviewed for radio after the P.A.D.D. Board meeting. In May of 1975, the Louisville Courier-Journal printed an article on the Statewide Basin planning, based on interviews with staff of the Kentucky Division of Water (Quality).

Public Involvement

The goal of the previous level of "information and education" was to provide the public with information sufficient to encourage them to advance to the next level--that of becoming "involved" in the planning process. This involvement should include key public officials, special concern groups, and individual citizens. Some of the LCRB "involvement" activities included ADD Board meetings, person-to-person meetings, and the public hearing.

Barren River ADD Board Meeting

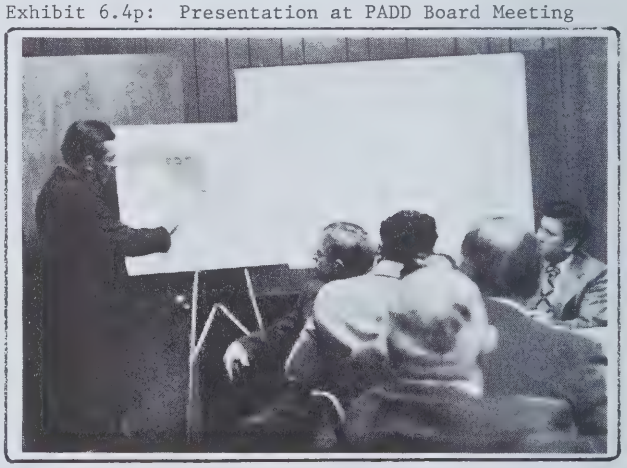
On February 24, 1975, the LCRB consultants, as well as the other consultants studying basins within the Barren River ADD, met with the ADD Board at its regular monthly meeting in Bowling Green, Ky. The purpose of the Statewide water quality management planning was described, certain aspects of the planning as it was related to the Barren River ADD were presented, and discussion was held with the Board members in attendance.

Pennyrile ADD Board Meeting

On March 5th, 1975, the LCRB consultants met with the Pennyrile ADD Board, at its regular monthly meeting in the ADD office at Hopkinsville, Kentucky. The presentation described the nature and purpose of the study, making use of the previously described report and exhibit boards, as shown by Exhibits 6.4p and 6.5p.

The meeting was attended by 50 persons, three-fifths of those being residents of the Lower Cumberland Basin Area. The audience was a wide mixture of the planning leadership within the Basin. Mayors, attorneys, media persons and planning commission members were in attendance, representing seven of the nine counties in the Lower Cumberland. During the discussion period that followed the GRW presentation, questions and suggestions were contributed from the Board. The

Exhibit 6.4p: Presentation at PADD Board Meeting



Pennyrile Area Development District requested additional River Basin Planning booklets that they would distribute to interested individuals. In all, 110 copies of the booklet were distributed.

Exhibit 6.5p: Answering Questions at PADD Meeting

Citizen's Workshop

On June 13th, 1975, a "citizen's workshop" was held at the Youth Center, Environmental Education Center, Land Between the Lakes State Park. The purpose of the workshop was to secure public involvement in the planning work for the Lower Cumberland River Basin and three other basins: Tennessee, Mississippi, and Ohio Rivers.

The workshop was sponsored by the Kentucky Environmental Quality Commission. Meeting invitations were sent to many special interest groups including the Audubon Society, Sierra Club, sewer treatment plant operators, Corps of Engineers, U.S. Geologic Survey, Soil Conservation Service, Kentucky Municipal League and State Universities, as well as elected officials, Area Development Districts, environmental committees, Chamber of Commerces, League of Women Voters, and Sportsmen's clubs.

The workshop program was under the direction of the Chairperson for the Ky. Environmental Quality Commission. Short presentations were made by the consultants for the LCRB and the other basins, using maps, charts, and other graphic display items. The summary chapter of the "Lower Cumberland River Basin Water Quality Management Plan" was distributed to persons in attendance.

Issues presented and discussed at the workshop included the levels of treatment required by the plan, financing of treatment facilities, and project priorities.

Key Public Officials

Visits were made by the LCRB consultants to the offices of some of the key public officials within the basin. In these person-to-person meetings, use was made of the previously described exhibit boards and special summary reports. Any information or characteristics applying to the officials own city or county were given special attention.

Public Hearing

The third, and final, phase of the public participation process, was the public hearing, which is the last step prior to public adoption of the River Basin Plan. The interested groups and individuals invited to the workshops were encouraged to attend the statewide public hearing held in Frankfort during the last week of June. The hearing was advertised for thirty days throughout the state prior to the date of the hearing. Consultants for each river basin were present and available to answer questions.

Appendix A-1

WATER QUALITY DATA

INTRODUCTION

Exhibit A-1.1t contains a summary of the data available on the water quality in the Lower Cumberland River Basin. This data was taken from the U.S. Environmental Protection Agency STORET files for Kentucky. Parameters listed are those which are generally considered important to water quality, and for which actual data was available. A list of station codes and locations is provided above the exhibit.

Flow values are listed in cubic feet per second (cfs), temperature in degrees, Farenheit, and pH in Standard Units. Values for pH indicate the relative acidity of the water, where pH=7 indicates a neutral condition. Values less than seven show acidity, whereas values greater than seven show alkalinity. All other parameters are given in milligrams per liter (mg/l).

*Station Code and Location for Exhibit A-1.1t

1..Town Spring, Guthrie, Kentucky
2..Little River, near Cadiz, Kentucky
3..Little River, above Cadiz, Kentucky
4..Red River, Near Adairville, Kentucky
5..Eddy Creek, near Lamasco, Kentucky
6..Crab Creek, near Ky. 373 bridge
7..McElory Creek, a tributary to Skinframe Creek at Lyon-Caldwell Co. Line
8..Livingston Creek, near Dycusburg, Kentucky
9..Livingston Creek, below Dry Fork on Lyon-Crittenden Co. Line
10..Livingston Creek, above Dry Fork on Lyon-Crittenden Co. Line
11..Cumberland River - Lake Barkley at Milepoint 80.0 - 6 mile below Ky.-Tenn. State Line
12..U.T. to Lick Creek at Latitude 37°05'41", Longitude 088°02'21"
13..Barkley Canal - Kentucky Lake - Lake Barkley Milepoint 32.7
14..Cumberland River at Smithland - USGS Flow Gage near U.S. 60

Exhibit A-1.2t shows the average stream slopes and elevation changes for each of the significant streams in the Lower Cumberland River Basin.

Exhibit A-1.2t: Slopes and Elevations of Streams

Stream	Average Slope, in feet/mile	Elevation	
		Head	Mouth
South Fork Red River...	5.28	530	468
Elk Fork.....	6.64	650	470
Big West Fork.....	6.44	600	400
Red River.....	4.4	600	450
South Fork Little River	7.58	660	475
Caney Creek.....	26.18	448	359
Little River	2.39	550	359
Dry Creek	15.17	450	362
Eddy Creek	4.15	450	359
Hammond Creek	27.9	490	359
Caldwell Springs	20.0	373	329
Crab Creek	17.87	428	319
Panther Creek	20.55	420	307
Livingston Creek	2.37	329	302
Cox Spring Branch	35.7	426	355
Sandy Creek	5.31	319	302
Clear Branch	22.0	330	319
Knob Creek	21.3	393	359
Lick Creek	4.4	370	359
Blue Spring Creek	0	359	359
Montgomery Creek	15	620	461
McCormick Creek	19.35	332	302

Exhibit A-1.1t: Water Quality Data for the Lower Cumberland River Basin

Water Quality Parameter	Station Code*(see above listing)													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Flow..... cfs	1.11	72	618	136	18	----	----	11.5	----	----	----	----	----	27,370
Temperature..... °F	58	70	----	69	60	65	58	64	62	61	67	59	----	----
pH..... SU	7.3	8.2	7.4	8.1	7.9	7.4	8.0	7.9	----	----	7.2	7.2	----	----
Dissolved Solids mg/l	224	215	188	181	255	281	418	299	235	306	----	166	----	----
Hardness (Total) mg/l	195	176	156	171	207	250	330	207	200	260	----	150	----	----
NH_3-Nitrogen.... mg/l	----	----	----	----	----	----	----	----	----	----	0.09	----	0.13	----
Phosphorous..... mg/l	----	0.87	----	0.11	0.27	----	0.06	0.06	----	----	0.16	----	0.09	----
Calcium..... mg/l	70.00	----	56.0	----	----	82.0	84.0	----	64.0	92.0	26.7	52.0	----	----
Magnesium..... mg/l	5.75	----	4.5	----	----	12.0	32.0	----	10.0	7.8	4.7	5.4	----	----
Sodium and Potassium..... mg/l	3.80	----	6.1	----	----	8.2	32.6	----	----	----	5.7	5.7	----	----
Sulfate..... mg/l	9.00	14.4	11.0	9.7	15.0	6.0	73.0	14.3	19.0	8.9	20.2	6.9	----	----
Chloride..... mg/l	4.15	0.13	5.4	3.5	10.1	20.0	55.0	37.4	2.1	2.6	4.3	2.3	----	----
Nitrate..... mg/l	14.67	----	5.4	9.0	9.5	----	0.20	4.35	----	0.86	0.56	0.0	0.36	----

Appendix A-2: LOWER CUMBERLAND RIVER BASIN DISAGGREGATION OF

POPULATION TRENDS & PROJECTIONS

INTRODUCTION

The number of people living in a community represent one factor in determining wastewater treatment loads. It was the purpose of this appendix to provide information on the number of people projected to live in the Lower Cumberland River Basin and its segment basins for 1975, 1980, and 1995.

County population projections were taken, or interpolated, from the 1972 E.P.A. Region IV report, and urban area percentages came from the 1972 Kentucky Program Development Office report. These projections also had to be disaggregated to county river basin and to river basin subdivisions (called segment basins). These county subdivision figures then were aggregated to provide segment basin and Lower Cumberland River Basin figures.

Six population tables are included in this appendix. Three of the tables use the County as the beginning point for disaggregation into the river basins and segment basins located in each county, and the other three tables use the segment basin as the prime area of consideration. A map of the twenty-two segment basins are included in Appendix B, Exhibit B-1m.

The three "county" tables are:

...Exhibit A-2t, which provides "at year" population figures for 1960, 1970, 1975, 1980, and 1995, for areal units including the nine Lower Cumberland counties, individual counties (see map below), inside and outside of the L.C.R.B., segment basins, urban, rural, and rural farm and non-farm.

...Exhibit A-2.1t, which provides "between-year" changes in number and percent, for the areal units listed above.

...Exhibit A-2.2t, which provides population density figures (persons per square mile) for the years and areal units previously described.

The three "segment basin" tables are:

...Exhibit A-2.3t, which provides "at-year" population for 1960, 1970, 1975, 1980, and 1995.

...Exhibit A-2.4t, which shows "between-year" number and per cent changes.

...Exhibit A-2.5t, which provides population density figures for the above years.

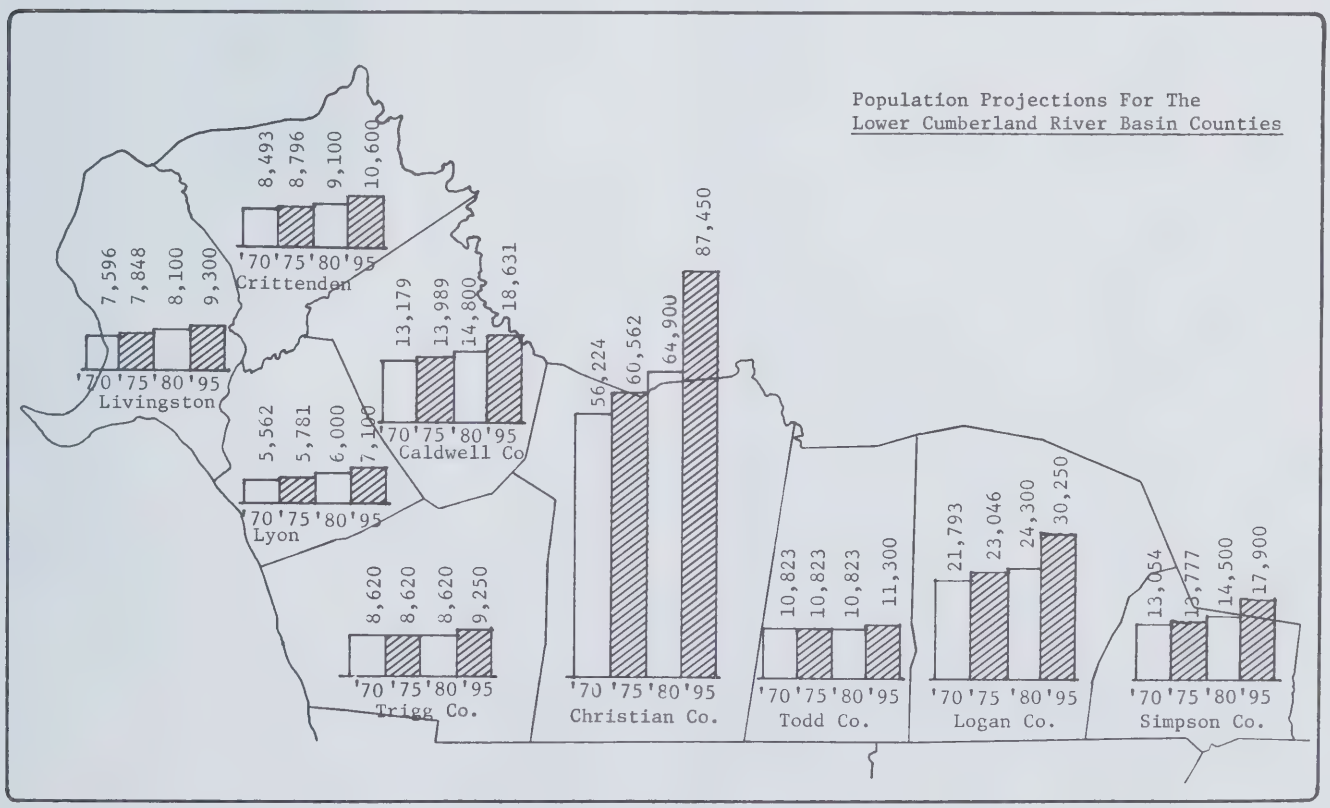


Exhibit A-2t-County and Sub-Area "At-Year" Population Trends (1960-1970)and Projections (1975-1995)

Area Breakdown	Population Trends		Population Projections		
	1960*1	1970*1	1975*3	1980*3	1995*3
STATE OF KENTUCKY	3,038,156*1	3,219,311*1	3,390,705	3,562,100	4,274,150
NINE-COUNTY TOTAL.....	144,255*1	145,344*1	153,242	161,143	201,781
..Urban.....	36,263*1	57,175*1	62,278	66,647	88,343
..Rural.....	107,992*1	88,169*1	90,964	94,496	113,438
..Farm.....	40,791*1	35,232*1	36,713	38,168	45,752
..Non-Farm.....	67,201*1	52,937*1	54,251	56,328	67,686
..Outside LCRB.....	56,815*2	53,586*2	55,347	57,921	70,644
..Urban.....	11,209*2	16,000*2	16,103	17,020	21,271
..Rural.....	45,606*2	37,586*2	39,244	40,901	49,373
..Farm.....	18,845*2	16,681*2	17,596	18,348	22,096
..Non-Farm.....	26,761*2	20,905*2	21,648	22,353	27,277
..Inside LCRB.....	87,440*2	91,758*2	97,895	103,222	131,137
..Urban.....	25,054*2	41,175*2	46,175	49,627	67,084
..Rural.....	62,386*2	50,583*2	51,720	53,595	64,053
..Farm.....	21,946*2	18,551*2	19,117	19,820	23,652
..Non-Farm.....	40,440*2	32,032*2	32,603	33,775	40,401
LIVINGSTON COUNTY TOTAL.....	7,029*1	7,596*1	7,848	8,100	9,300
..Urban.....	- *1	- *1	-	-	-
..Rural.....	7,029*1	7,596*1	7,848	8,100	9,300
..Farm.....	5,412*1	5,849*1	6,043	6,237	7,161
..Non-Farm.....	1,617*1	1,747*1	1,805	1,863	2,139
..Outside LCRB.....	4,288	4,634	4,787	4,941	5,673
..North of LCRB.....	3,022	3,266	3,374	3,483	3,999
..Urban.....	-	-	-	-	-
..Rural.....	3,022	3,266	3,374	3,483	3,999
..Farm.....	2,327	2,515	2,598	2,682	3,079
..Non-Farm.....	695	751	776	801	920
..South of LCRB.....	1,266	1,368	1,413	1,458	1,674
..Urban.....	-	-	-	-	-
..Rural.....	1,266	1,368	1,413	1,458	1,674
..Farm.....	975	1,053	1,088	1,123	1,289
..Non-Farm.....	291	315	325	335	385
..Inside LCRB.....	2,741	2,962	3,061	3,159	3,627
..Urban.....	-	-	-	-	-
..Rural.....	2,741	2,962	3,061	3,159	3,627
..Farm.....	2,111	2,281	2,357	2,432	2,793
..Non-Farm.....	630	681	704	727	834
..#1 Segment Basin.....	1,546	1,671	1,726	1,782	2,046
..Urban.....	-	-	-	-	-
..Rural.....	1,546	1,671	1,726	1,782	2,046
..Farm.....	1,190	1,287	1,329	1,372	1,575
..Non-Farm.....	356	384	397	410	471
..#2 Segment Basin.....	703	760	785	810	930
..Urban.....	-	-	-	-	-
..Rural.....	703	760	785	810	930
..Farm.....	541	585	585	585	677
..Non-Farm.....	162	175	200	225	253

*1-From 1970 U.S. Census.
*2-Areas outside LCRB, inside LCRB, and LCRB segments drafted on maps; urban and small community population extracted; and remaining rural population estimated proportionate to land area.
*3-County projections from EPA Region IV report; urban projections from K.P.D.O. 1972 report; and remaining rural farm and non-farm projected to continue 1970 proportional split.

(con't) Exhibit A-2t-County and Sub-Area "At-Year" Population Trends (1960-1970) and Projections (1975-1995)

Area Breakdown	Population Trends		Population Projections		
	1960	1970	1975	1980	1995
..#4 Segment Basin.....	464	501	518	535	614
..Urban.....	-	-	-	-	-
..Rural.....	464	501	518	535	614
..Farm.....	357	386	399	412	473
..Non-Farm.....	107	115	119	123	141
..#5 Segment Basin.....	28	30	31	32	37
..Urban.....	-	-	-	-	-
..Rural.....	28	30	31	32	37
..Farm.....	22	23	24	25	28
..Non-Farm.....	6	7	7	7	9
CRITTENDEN COUNTY TOTAL.....	8,648	8,493	8,796	9,100	10,600
..Urban (Marion).....	-	3,008	3,201	3,403	4,282
..Rural.....	8,648	5,485	5,595	5,697	6,318
..Farm.....	2,594	1,646	1,678	1,709	1,895
..Non-Farm.....	6,054	3,839	3,917	3,988	4,423
..Outside LCRB.....	6,659	7,231	7,509	7,790	9,146
..Urban (Marion).....	-	3,008	3,201	3,403	4,282
..Rural.....	6,659	4,223	4,308	4,387	4,864
..Farm.....	1,998	1,267	1,292	1,316	1,459
..Non-farm.....	4,661	2,956	3,016	3,071	3,405
..Inside LCRB.....	1,989	1,261	1,287	1,310	1,454
..Urban.....	-	-	-	-	-
..Rural.....	1,989	1,261	1,287	1,310	1,454
..Farm.....	597	379	386	393	436
..Non-Farm.....	1,392	882	901	917	1,018
..#1 Segment Basin.....	1,074	681	694	707	785
..Urban.....	-	-	-	-	-
..Rural.....	1,074	681	694	707	785
..Farm.....	322	204	208	212	235
..Non-Farm.....	752	477	486	495	550
..#2 Segment Basin.....	80	50	51	52	58
..Urban.....	-	-	-	-	-
..Rural.....	80	50	51	42	58
..Farm.....	24	15	15	16	17
..Non-Farm.....	56	35	36	36	41
..#3 Segment Basin.....	835	530	540	550	611
..Urban.....	-	-	-	-	-
..Rural.....	835	530	540	550	611
..Farm.....	250	160	162	165	183
..Non-Farm.....	585	370	378	385	428
LYON COUNTY TOTAL.....	5,924	5,562	5,781	6,000	7,100
..Urban.....	-	-	-	-	-
..Rural.....	5,924	5,562	5,781	6,000	7,100
..Farm.....	1,540	1,446	1,503	1,560	1,846
..Non-Farm.....	4,384	4,116	4,278	4,440	5,254
..Outside LCRB.....	-	-	-	-	-
..Urban.....	-	-	-	-	-
..Rural.....	-	-	-	-	-
..Farm.....	-	-	-	-	-
..Non-Farm.....	-	-	-	-	-

(con't) Exhibit A-2t-County and Sub-Area "At Year" Population Trends (1960-1970) and Projections (1975-1995)

Area Breakdown	Population Trends		Population Projections		
	1960	1970	1975	1980	1995
..Inside LCRB	5,924	5,562	5,781	6,000	7,100
..Urban	-	-	-	-	-
..Rural	5,924	5,562	5,781	6,000	7,100
..Farm	1,540	1,446	1,503	1,560	1,846
..Non-Farm	4,384	4,116	4,278	4,440	5,254
..#3 Segment Basin	1,995	1,880	1,936	2,019	2,393
..Urban	-	-	-	-	-
..Rural	1,995	1,880	1,936	2,019	2,393
..Farm	461	435	446	466	552
..Non-Farm	1,534	1,445	1,490	1,553	1,841
..#4 Segment Basin	998	940	968	1,010	1,196
..Urban	-	-	-	-	-
..Rural	998	940	968	1,010	1,196
..Farm	230	217	223	233	276
..Non-Farm	768	723	745	777	920
..#5 Segment Basin	1,683	1,567	1,667	1,710	2,015
..Urban	-	-	-	-	-
..Rural	1,683	1,567	1,667	1,710	2,015
..Farm	561	522	556	570	672
..Non-Farm	1,122	1,045	1,111	1,140	1,343
..#6 Segment Basin	374	352	363	378	449
..Urban	-	-	-	-	-
..Rural	374	352	363	378	449
..Farm	86	82	84	87	104
..Non-Farm	288	270	279	291	345
..#7 Segment Basin	250	235	242	252	299
..Urban	-	-	-	-	-
..Rural	250	235	242	252	299
..Farm	58	54	56	58	69
..Non-Farm	192	181	186	194	230
..#8 Segment Basin	624	588	605	631	748
..Urban	-	-	-	-	-
..Rural	624	588	605	631	748
..Farm	144	136	138	146	173
..Non-Farm	480	452	467	485	575
CALDWELL COUNTY TOTAL	13,072	13,179	13,989	14,800	18,631
..Urban (Princeton)	5,618	6,292	6,911	7,578	10,499
..Rural	7,454	6,887	7,078	7,222	8,132
..Farm	2,459	2,273	2,336	2,383	2,684
..Non-Farm	4,995	4,614	4,742	4,839	5,448
..Outside LCRB	4,736	4,486	4,655	4,802	5,594
..Urban (Princeton)	562	629	691	758	1,051
..Rural	4,174	3,857	3,964	4,044	4,543
..Farm	1,377	1,273	1,308	1,334	1,449
..Non-Farm	2,797	2,584	2,656	2,710	3,044
..Inside LCRB	8,336	8,693	9,334	9,998	13,037
..Urban (Princeton)	5,056	5,663	6,220	6,820	9,467
..Rural	3,280	3,030	3,114	3,178	3,570
..Farm	1,082	1,000	1,028	1,049	1,178
..Non-Farm	2,198	2,030	2,086	2,129	2,392

(con't) Exhibit A-2t-County and Sub-Area "At-Year" Population Trends (1960-1970) and Projections (1975-1995)

Area Breakdown	Population Trends		Population Projections		
	1960	1970	1975	1980	1995
..#3 Segment Basin.....	460	424	436	445	500
..Urban.....	-	-	-	-	-
..Rural.....	460	424	436	445	500
..Farm.....	152	140	144	147	165
..Non-Farm.....	308	284	292	298	335
..#5 Segment Basin.....	492	454	467	477	536
..Urban.....	-	-	-	-	-
..Rural.....	492	454	467	477	536
..Farm.....	162	150	154	157	177
..Non-Farm.....	330	304	313	320	359
..#8 Segment Basin.....	6,368	6,875	7,465	8,091	10,895
..Urban (Princeton).....	5,056	5,663	6,220	6,820	9,467
..Rural.....	1,312	1,212	1,245	1,271	1,428
..Farm.....	433	400	411	419	471
..Non-Farm.....	879	812	834	852	957
..#9 Segment Basin.....	1,017	939	965	985	1,106
..Urban.....	-	-	-	-	-
..Rural.....	1,017	939	965	985	1,106
..Farm.....	336	310	318	325	365
..Non-Farm.....	681	629	647	660	741
TRIGG COUNTY TOTAL.....	8,870	8,620	8,620	8,620	9,250
..Urban.....	-	-	-	-	-
..Rural.....	8,870	8,620	8,620	8,620	9,250
..Farm.....	2,838	2,758	2,758	2,758	2,960
..Non-Farm.....	6,032	5,862	5,862	5,862	6,290
..Outside LCRB.....	-	-	-	-	-
..Urban.....	-	-	-	-	-
..Rural.....	-	-	-	-	-
..Farm.....	-	-	-	-	-
..Non-Farm.....	-	-	-	-	-
..Inside LCRB.....	8,870	8,620	8,620	8,620	9,250
..Urban.....	-	-	-	-	-
..Rural.....	8,870	8,620	8,620	8,620	9,250
..Farm.....	2,838	2,758	2,758	2,758	2,960
..Non-Farm.....	6,032	5,862	5,862	5,862	6,290
..#5 Segment Basin.....	1,827	1,775	1,775	1,775	1,905
..Urban.....	-	-	-	-	-
..Rural.....	1,827	1,775	1,775	1,775	1,905
..Farm.....	585	569	569	569	643
..Non-Farm.....	1,242	1,206	1,206	1,206	1,262
..#8 Segment Basin.....	126	122	122	122	131
..Urban.....	-	-	-	-	-
..Rural.....	126	122	122	122	131
..Farm.....	40	39	39	39	41
..Non-Farm.....	86	83	83	83	90
..#9 Segment Basin.....	1,761	1,711	1,711	1,711	1,836
..Urban.....	-	-	-	-	-
..Rural.....	1,761	1,711	1,711	1,711	1,836
..Farm.....	563	546	546	546	579
..Non-Farm.....	1,198	1,165	1,165	1,165	1,257

(con't) Exhibit A-2t-County and Sub-Area "At-Year" Population Trends (1960-1970) and Projections (1975-1995)

Area Breakdown	Population Trends		Population Projections		
	1960	1970	1975	1980	1995
..#10 Segment Basin.....	4,527	4,400	4,400	4,400	4,722
..Urban.....	-	-	-	-	-
..Rural.....	4,527	4,400	4,400	4,400	4,722
..Farm.....	1,448	1,408	1,408	1,408	1,490
..Non-Farm.....	3,076	2,992	2,992	2,992	3,232
..#11 Segment Basin.....	629	612	612	612	656
..Urban.....	-	-	-	-	-
..Rural.....	629	612	612	612	656
..Farm.....	202	196	196	196	207
..Non-Farm.....	427	416	416	416	449
CHRISTIAN COUNTY TOTAL.....	56,904	56,224	60,562	64,900	87,450
..Urban (Hopkinsville Area).....	19,465	34,866	39,365	42,185	56,843
..Rural.....	37,439	21,358	21,197	22,715	30,607
..Farm.....	11,232	6,407	6,359	6,814	9,182
..Non-Farm.....	26,207	14,951	14,838	15,901	21,425
..Outside LCRB.....	13,478	7,689	7,631	8,177	11,019
..Urban.....	-	-	-	-	-
..Rural.....	13,478	7,689	7,631	8,177	11,019
..Farm.....	4,043	2,307	2,289	2,453	3,306
..Non-Farm.....	9,435	5,382	5,342	5,724	7,713
..Inside LCRB.....	43,426	48,535	52,931	56,723	76,431
..Urban.....	19,465	34,866	39,365	42,185	56,843
..Rural.....	23,961	13,669	13,566	14,538	19,588
..Farm.....	7,188	4,101	4,070	4,361	5,876
..Non-Farm.....	16,773	9,568	9,496	10,177	13,712
..#9 Segment Basin.....	1,605	916	909	974	1,312
..Urban.....	-	-	-	-	-
..Rural.....	1,605	916	909	974	1,312
..Farm.....	482	275	273	292	394
..Non-Farm.....	1,123	641	636	682	918
..#10 Segment Basin.....	5,943	3,390	3,364	3,605	4,858
..Urban.....	-	-	-	-	-
..Rural.....	5,943	3,390	3,364	3,605	4,858
..Farm.....	1,783	1,017	1,009	1,032	1,457
..Non-Farm.....	4,160	2,373	2,355	2,523	3,401
..#11 Segment Basin.....	4,505	2,570	2,550	2,733	3,682
..Urban.....	-	-	-	-	-
..Rural.....	4,505	2,570	2,550	2,733	3,682
..Farm.....	1,352	771	765	820	1,105
..Non-Farm.....	3,153	1,799	1,785	1,913	2,577
..#12 Segment Basin.....	2,564	1,463	1,452	1,556	2,096
..Urban.....	-	-	-	-	-
..Rural.....	2,564	1,463	1,452	1,556	2,096
..Farm.....	769	439	436	467	629
..Non-Farm.....	1,795	1,024	1,016	1,089	1,467
..#13 Segment Basin.....	14,746	22,670	25,355	27,172	36,613
..Urban.....	11,679	20,920	23,619	25,311	34,106
..Rural.....	3,067	1,750	1,736	1,861	2,507
..Farm.....	920	525	521	558	752
..Non-Farm.....	2,147	1,225	1,215	1,303	1,755

(con't) Exhibit A-2t-County and Sub-Area "At Year" Population Trends (1960-1970) and Projections (1975-1995)

Area Breakdown	Population Trends		Population Projections		
	1960	1970	1975	1980	1995
..#14 Segment Basin.....	11,188	15,887	17,672	18,938	25,519
..Urban.....	7,786	13,946	15,746	16,874	22,737
..Rural.....	3,402	1,941	1,926	2,064	2,782
..Farm.....	1,021	582	578	619	835
..Non-Farm.....	2,381	1,359	1,348	1,445	1,947
..#15 Segment Basin.....	982	560	556	596	803
..Urban.....	-	-	-	-	-
..Rural.....	982	560	556	596	803
..Farm.....	295	168	167	179	241
..Non-Farm.....	687	392	389	417	562
..#16 Segment Basin.....	1,677	957	950	1,018	1,371
..Urban.....	-	-	-	-	-
..Rural.....	1,677	957	950	1,018	1,371
..Farm.....	503	287	285	305	411
..Non-Farm.....	1,174	670	665	713	960
..#17 Segment Basin.....	144	82	81	87	118
..Urban.....	-	-	-	-	-
..Rural.....	144	82	81	87	118
..Farm.....	43	25	24	26	35
..Non-Farm.....	101	57	57	61	83
..#18 Segment Basin.....	72	41	41	44	59
..Urban.....	-	-	-	-	-
..Rural.....	72	41	41	44	59
..Farm.....	22	12	12	13	18
..Non-Farm.....	50	29	29	31	41
TODD COUNTY TOTAL.....	11,364	10,823	10,823	10,823	11,300
..Urban.....	-	-	-	-	-
..Rural.....	11,364	10,823	10,823	10,823	11,300
..Farm.....	3,750	3,572	3,572	3,572	3,729
..Non-Farm.....	7,614	7,251	7,251	7,251	7,571
..Outside LCRB.....	3,977	3,788	3,788	3,788	3,955
..Urban.....	-	-	-	-	-
..Rural.....	3,977	3,788	3,788	3,788	3,955
..Farm.....	1,312	1,250	1,250	1,250	1,305
..Non-Farm.....	2,665	2,538	2,538	2,538	2,650
..Inside LCRB.....	7,387	7,035	7,035	7,035	7,345
..Urban.....	-	-	-	-	-
..Rural.....	7,387	7,035	7,035	7,035	7,345
..Farm.....	2,438	2,322	2,322	2,322	2,424
..Non-Farm.....	4,949	4,713	4,713	4,713	4,921
..#14 Segment Basin.....	45	43	43	43	45
..Urban.....	-	-	-	-	-
..Rural.....	45	43	43	43	45
..Farm.....	15	14	14	14	15
..Non-Farm.....	30	29	29	29	30
..#15 Segment Basin.....	23	22	22	22	23
..Urban.....	-	-	-	-	-
..Rural.....	23	22	22	22	23
..Farm.....	8	7	7	7	8
.. Non-Farm.....	15	15	15	15	15

(con't) Exhibit A-2t-County and Sub-Area "At-Year" Population Trends (1960-1970) and Projections (1975-1995)

Area Breakdown	Population Trends		Population Projections		
	1960	1970	1975	1980	1995
..#16 Segment Basin.....	23	22	22	22	23
..Urban.....	-	-	-	-	-
..Rural.....	23	22	22	22	23
..Farm.....	8	7	7	7	8
..Non-Farm.....	15	15	15	15	15
..#17 Segment Basin.....	2,159	2,056	2,056	2,056	2,150
..Urban.....	-	-	-	-	-
..Rural.....	2,159	2,056	2,056	2,056	2,150
..Farm.....	727	693	693	693	724
..Non-Farm.....	1,432	1,363	1,363	1,363	1,426
..#18 Segment Basin.....	1,478	1,408	1,408	1,408	1,466
..Urban.....	-	-	-	-	-
..Rural.....	1,478	1,408	1,408	1,408	1,466
..Farm.....	473	451	451	451	470
..Non-Farm.....	1,005	957	957	957	996
..#19 Segment Basin.....	2,477	2,358	2,358	2,358	2,463
..Urban.....	-	-	-	-	-
..Rural.....	2,477	2,358	2,358	2,358	2,463
..Farm.....	817	778	778	778	813
..Non-Farm.....	1,660	1,580	1,580	1,580	1,650
..#20 Segment Basin.....	1,182	1,126	1,126	1,126	1,175
..Urban.....	-	-	-	-	-
..Rural.....	1,182	1,126	1,126	1,126	1,175
..Farm.....	390	372	372	372	388
..Non-Farm.....	792	754	754	754	787
LOGAN COUNTY TOTAL.....	20,896	21,793	23,046	24,300	30,250
..Urban-Russellville.....	5,861	6,456	6,464	6,811	8,485
..Rural.....	15,035	15,337	16,582	17,489	21,765
..Farm.....	6,916	7,055	7,628	8,045	10,012
..Non-Farm.....	8,119	8,282	8,954	9,444	11,753
..Outside LCRB.....	14,048	14,705	15,487	16,330	20,328
..Urban.....	5,328	5,810	5,870	6,189	7,704
..Rural.....	8,720	8,895	9,617	10,141	12,624
..Farm.....	4,011	4,092	4,424	4,665	5,807
..Non-Farm.....	4,709	4,803	5,193	5,476	6,817
..Inside LCRB.....	6,848	7,088	7,559	7,970	9,922
..Urban.....	533	646	590	622	774
..Rural.....	6,315	6,442	6,969	7,348	9,148
..Farm.....	2,905	2,963	3,206	3,380	4,208
..Non-Farm.....	3,410	3,479	3,763	3,968	4,940
..#19 Segment Basin.....	637	651	704	742	924
..Urban.....	-	-	-	-	-
..Rural.....	637	651	704	742	924
..Farm.....	293	300	324	341	425
..Non-Farm.....	344	351	380	401	499

(con't) Exhibit A-2t-County and Sub-Area "At Year" Population Trends (1960-1970) and Projections (1975-1995)

Area Breakdown	Population Trends		Population Projections		
	1960	1970	1975	1980	1995
..#20 Segment Basin.....	6,127	6,354	6,765	7,132	8,879
..Urban.....	533	646	590	622	774
..Rural.....	5,594	5,708	6,175	6,510	8,105
..Farm.....	2,573	2,626	2,840	2,995	3,728
..Non-Farm.....	3,021	3,082	3,335	3,515	4,377
..#21 Segment Basin.....	84	84	91	96	119
..Urban.....	-	-	-	-	-
..Rural.....	84	84	91	96	119
..Farm.....	39	39	42	44	55
..Non-Farm.....	45	45	49	52	64
SIMPSON COUNTY TOTAL.....	11,548	13,054	13,777	14,500	17,900
..Urban-Franklin.....	5,319	6,553	6,337	6,670	8,234
..Rural.....	6,229	6,501	7,440	7,830	9,666
..Farm.....	4,049	4,226	4,836	5,090	6,283
..Non-Farm.....	2,180	2,275	2,604	2,740	3,383
..Outside LCRB.....	9,629	11,052	11,490	12,093	14,929
..Urban.....	5,319	6,553	6,337	6,670	8,234
..Rural.....	4,310	4,499	5,153	5,423	6,695
..Farm.....	2,802	2,924	3,349	3,525	4,352
..Non-Farm.....	1,508	1,575	1,804	1,898	2,343
..Inside LCRB.....	1,919	2,002	2,287	2,407	2,971
..Urban.....	-	-	-	-	-
..Rural.....	1,919	2,002	2,287	2,407	2,971
..Farm.....	1,247	1,301	1,487	1,565	1,931
..Non-Farm.....	672	701	800	842	1,040
..#20 Segment Basin.....	1,898	1,980	2,262	2,380	2,938
..Urban.....	-	-	-	-	-
..Rural.....	1,898	1,980	2,262	2,380	2,938
..Farm.....	1,234	1,287	1,470	1,547	1,910
..Non-Farm.....	664	693	792	833	1,028
..#22 Segment Basin.....	21	22	25	27	33
..Urban.....	-	-	-	-	-
..Rural.....	21	22	25	27	33
..Farm.....	14	14	16	18	21
..Non-Farm.....	7	8	9	9	12

Exhibit A-2.1t-County and Sub-Area "Between Year" Changes in Population Trends and Projections

Area Breakdown	Population Trends				Population Projections			
	1960-70		1970-75		1975-80		1980-95	
	No.	(%)*	No.	(%)*	No.	(%)*	No.	(%)*
STATE OF KENTUCKY	181,155	6.00	171,394	5.00	171,395	5.00	712,050	20.0
NINE-COUNTY TOTAL.....	1,089	.75	7,898	5.4	7,901	5.16	40,638	25.22
..Outside LCRB.....	-3,229	-5.68	1,761	3.28	2,574	4.65	12,723	21.97
..Urban.....	4,791	42.74	103	.64	917	5.69	4,251	24.98
..Rural.....	-8,020	-17.58	1,658	4.41	1,657	4.22	8,472	20.75
..Farm.....	-2,164	-11.48	915	5.48	752	4.27	3,748	20.43
..Non-Farm.....	-5,856	-21.88	743	3.55	905	4.18	4,724	20.95
..Inside LCRB.....	4,318	4.94	6,137	6.69	5,327	5.44	27,915	27.04
..Urban.....	16,121	64.34	5,000	12.14	3,452	7.48	17,457	35.18
..Rural.....	-11,803	-18.92	1,137	2.25	1,875	3.62	10,458	19.51
..Farm.....	-3,395	-15.47	566	3.05	703	3.68	3,832	19.33
..Non-Farm.....	-8,408	-20.79	571	1.78	1,172	3.59	6,626	19.62
LIVINGSTON COUNTY TOTAL....	567	8.07	252	3.32	252	3.21	1,200	14.81
..Urban.....	0	0	0	0	0	0	0	0
..Rural.....	567	8.07	252	3.32	252	3.21	1,200	14.81
..Farm.....	437	8.07	194	3.32	194	3.21	924	14.81
..Non-Farm.....	130	8.04	58	3.32	58	3.21	276	14.81
..Outside LCRB.....	346	8.07	153	3.30	154	3.22	732	14.81
..North of LCRB.....	244	8.07	108	3.31	109	3.13	516	14.81
..Urban.....	0	0	0	0	0	0	0	0
..Rural.....	244	8.07	108	3.31	109	3.13	516	14.81
..Farm.....	188	8.08	83	3.3	84	3.23	397	14.80
..Non-Farm.....	56	8.06	25	3.3	25	3.22	119	14.86
..South of LCRB.....	102	-	45	-	45	-	216	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	102	-	45	-	45	-	216	-
..Farm.....	78	-	35	-	35	-	166	-
..Non-Farm.....	24	-	10	-	10	-	50	-
..Inside LCRB.....	221	8.06	99	3.34	98	3.2	468	14.18
..Urban.....	0	0	0	0	0	0	0	0
..Rural.....	221	8.06	99	3.34	98	3.2	468	14.18
..Farm.....	170	8.05	76	3.33	75	3.18	361	14.84
..Non-Farm.....	51	8.09	23	3.38	23	3.27	107	14.72
..#1 Segment Basin.....	125	-	55	-	56	-	264	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	125	-	55	-	56	-	264	-
..Farm.....	97	-	42	-	43	-	203	-
..Non-Farm.....	28	-	13	-	13	-	61	-
..#2 Segment Basin.....	57	-	25	-	25	-	120	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	57	-	25	-	25	-	120	-
..Farm.....	44	-	0	-	0	-	92	-
..Non-Farm.....	13	-	25	-	25	-	28	-
..#4 Segment Basin.....	37	-	17	-	17	-	79	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	37	-	17	-	17	-	79	-
..Farm.....	29	-	13	-	13	-	61	-
..Non-Farm.....	8	-	4	-	4	-	18	-

*All percentage figures read horizontally. For instance, the nine county total population grew from 144,255 in 1960, to 145,344 in 1970; an increase of 1,089 or 0.75%. Percentage changes were not figured at segment level or below.

(con't) Exhibit A-2.1t-County and Sub-Area "Between Year" Changes in Population Trends and Projections

Area Breakdown	Population Trends				Population Projections			
	1960-70		1970-75		1975-80		1980-95	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
..#5 Segment Basin.....	2	-	1	-	1	-	5	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	2	-	1	-	1	-	5	-
..Farm.....	1	-	1	-	1	-	3	-
..Non-Farm.....	1	-	0	-	0	-	2	-
CRITTENDEN COUNTY TOTAL....	-155	-1.79	303	3.57	304	3.46	1,500	16.48
..Urban.....	3,008	34.78	193	6.42	202	6.31	879	25.83
..Rural.....	-3,163	-36.57	110	2.00	102	1.82	621	10.9
..Farm.....	-948	-36.54	32	1.94	31	1.85	186	10.88
..Non-Farm.....	-2,215	-36.59	78	2.03	71	1.81	435	10.91
..Outside LCRB.....	572	-8.59	277	3.84	281	3.74	1,356	17.41
..Urban.....	3,008	34.78	193	6.42	202	6.31	879	25.83
..Rural.....	-2,436	-36.58	84	2.01	79	1.83	477	10.87
..Farm.....	-731	-36.6	24	1.97	24	1.86	143	10.87
..Non-Farm.....	-1,705	-36.58	60	2.03	55	1.82	334	10.88
..Inside LCRB.....	-728	-36.6	26	2.06	23	1.79	144	10.99
..Urban.....	0	0	0	0	0	0	0	0
..Rural.....	-728	-36.6	26	2.06	23	1.79	144	10.99
..Farm.....	-218	-36.52	7	1.85	7	1.81	43	10.94
..Non-Farm.....	-510	-36.64	19	2.15	16	1.78	101	11.01
..#1 Segment Basin.....	-393	-	13	-	13	-	78	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-393	-	13	-	13	-	78	-
..Farm.....	-118	-	4	-	4	-	23	-
..Non-Farm.....	-275	-	9	-	9	-	55	-
..#2 Segment Basin.....	-30	-	1	-	1	-	6	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-30	-	1	-	1	-	6	-
..Farm.....	-9	-	0	-	1	-	1	-
..Non-Farm.....	-21	-	1	-	0	-	5	-
..#3 Segment Basin.....	-305	-	10	-	10	-	61	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-305	-	10	-	10	-	61	-
..Farm.....	-90	-	2	-	3	-	18	-
..Non-Farm.....	-215	-	8	-	7	-	43	-
LYON COUNTY TOTAL.....	-362	-6.11	219	3.94	219	3.79	1,100	18.33
..Urban.....	0	0	0	0	0	0	0	0
..Rural.....	-362	-6.11	219	3.94	219	3.79	1,100	18.33
..Farm.....	-94	-6.10	57	3.94	57	3.79	286	18.33
..Non-Farm.....	-268	-6.11	162	3.94	162	3.79	814	18.33
..Outside LCRB.....	0	0	0	0	0	0	0	0
..Urban.....	0	0	0	0	0	0	0	0
..Rural.....	0	0	0	0	0	0	0	0
..Farm.....	0	0	0	0	0	0	0	0
..Non-Farm.....	0	0	0	0	0	0	0	0
..Inside LCRB.....	-362	-6.11	219	3.94	219	3.79	1,100	18.33
..Urban.....	0	0	0	0	0	0	0	0
..Rural.....	-362	-6.11	219	3.94	219	3.79	1,100	18.33
..Farm.....	-94	-6.10	57	3.94	57	3.79	286	18.33
..Non-Farm.....	-268	-6.11	162	3.94	162	3.79	814	18.33

(con't) Exhibit A-2.1t-County and Sub-Area "Between Year" Changes in Population Trends and Projections

Area Breakdown	Population Trends				Population Projections			
	1960-70		1970-75		1975-80		1980-95	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
..#3 Segment Basin.....	-115	-	56	-	83	-	374	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-115	-	56	-	83	-	374	-
..Farm.....	-26	-	11	-	20	-	86	-
..Non-Farm.....	-89	-	45	-	63	-	288	-
..#4 Segment Basin.....	-58	-	28	-	42	-	186	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-58	-	28	-	42	-	186	-
..Farm.....	-13	-	6	-	10	-	43	-
..Non-Farm.....	-45	-	22	-	32	-	143	-
..#5 Segment Basin.....	-116	-	100	-	43	-	305	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-116	-	100	-	43	-	305	-
..Farm.....	-39	-	34	-	14	-	102	-
..Non-Farm.....	-77	-	66	-	29	-	203	-
..#6 Segment Basin.....	-22	-	11	-	15	-	71	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-22	-	11	-	15	-	71	-
..Farm.....	-4	-	2	-	3	-	17	-
..Non-Farm.....	-18	-	9	-	12	-	54	-
..#7 Segment Basin.....	-15	-	7	-	10	-	47	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-15	-	7	-	10	-	47	-
..Farm.....	-4	-	2	-	2	-	11	-
..Non-Farm.....	-11	-	5	-	8	-	36	-
..#8 Segment Basin.....	-36	-	17	-	26	-	117	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-36	-	17	-	26	-	117	-
..Farm.....	-8	-	2	-	8	-	27	-
..Non-Farm.....	-28	-	15	-	18	-	90	-
CALDWELL COUNTY TOTAL.....	107	.82	810	6.15	811	5.80	3,831	25.88
..Urban (Princeton).....	674	12.0	619	9.84	667	9.65	2,921	38.54
..Rural.....	-567	-7.61	191	2.77	144	2.03	910	12.60
..Farm.....	-186	-7.56	63	2.77	47	2.01	301	12.63
..Non-Farm.....	-381	-7.63	128	2.77	97	2.04	609	12.58
..Outside LCRB.....	-250	-1.91	169	3.77	147	3.16	792	16.49
..Urban (Princeton).....	67	11.92	62	9.86	67	9.7	293	38.65
..Rural.....	-317	-7.59	107	2.77	80	2.02	499	12.34
..Farm.....	-104	-7.55	35	2.75	26	1.99	165	12.37
..Non-Farm.....	-213	-7.62	72	2.79	54	2.03	334	12.32
..Inside LCRB.....	357	4.28	641	7.37	664	7.11	3,039	30.39
..Urban (Princeton).....	607	12.0	557	9.84	600	9.65	2,647	38.81
..Rural.....	-250	-7.62	84	2.77	64	2.09	392	12.33
..Farm.....	-82	-7.58	28	2.8	21	2.04	129	12.29
..Non-Farm.....	-168	-7.64	56	2.76	43	2.06	263	12.35
..#3 Segment Basin.....	-36	-	12	-	9	-	55	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-36	-	12	-	9	-	55	-
..Farm.....	-12	-	4	-	3	-	18	-
..Non-Farm.....	-24	-	8	-	6	-	37	-

(con't) Exhibit A-2.1t-County and Sub-Area "Between Year" Changes in Population Trends and Projections

Area Breakdown	Population Trends				Population Projections			
	1960-70		1970-75		1975-80		1980-95	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
..#5 Segment Basin.....	-38	-	13	-	10	-	59	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-38	-	13	-	10	-	59	-
..Farm.....	-12	-	4	-	3	-	20	-
..Non-Farm.....	-26	-	9	-	7	-	39	-
..#8 Segment Basin.....	507	-	590	-	626	-	2,804	-
..Urban.....	607	-	557	-	600	-	2,647	-
..Rural.....	-100	-	33	-	26	-	157	-
..Farm.....	-33	-	11	-	8	-	52	-
..Non-Farm.....	-67	-	22	-	18	-	105	-
..#9 Segment Basin.....	-78	-	26	-	20	-	121	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-78	-	26	-	20	-	121	-
..Farm.....	-26	-	8	-	7	-	40	-
..Non-Farm.....	-52	-	18	-	13	-	81	-
TRIGG COUNTY TOTAL.....	-250	-2.82	0	0	0	0	630	7.31
..Urban.....	0	0	0	0	0	0	0	0
..Rural.....	-250	-2.82	0	0	0	0	630	7.31
..Farm.....	-80	-2.82	0	0	0	0	202	7.32
..Non-Farm.....	-170	-2.82	0	0	0	0	428	7.30
..Outside LCRB.....	0	0	0	0	0	0	0	0
..Urban.....	0	0	0	0	0	0	0	0
..Rural.....	0	0	0	0	0	0	0	0
..Farm.....	0	0	0	0	0	0	0	0
..Non-Farm.....	0	0	0	0	0	0	0	0
..Inside LCRB.....	-249	-2.82	0	0	0	0	630	7.31
..Urban.....	0	0	0	0	0	0	0	0
..Rural.....	-249	-2.82	0	0	0	0	630	7.31
..Farm.....	-80	-2.82	0	0	0	0	202	7.32
..Non-Farm.....	-170	-2.82	0	0	0	0	428	7.30
..#5 Segment Basin.....	-52	-	0	0	0	0	130	-
..Urban.....	0	-	0	0	0	0	0	-
..Rural.....	-52	-	0	0	0	0	130	-
..Farm.....	-16	-	0	0	0	0	74	-
..Non-Farm.....	-36	-	0	0	0	0	56	-
..#8 Segment Basin.....	-4	-	0	0	0	0	9	-
..Urban.....	0	-	0	0	0	0	0	-
..Rural.....	-4	-	0	0	0	0	9	-
..Farm.....	-1	-	0	0	0	0	2	-
..Non-Farm.....	-3	-	0	0	0	0	7	-
..#9 Segment Basin.....	-50	-	0	0	0	0	125	-
..Urban.....	0	-	0	0	0	0	0	-
..Rural.....	-50	-	0	0	0	0	125	-
..Farm.....	-17	-	0	0	0	0	33	-
..Non-Farm.....	-33	-	0	0	0	0	92	-
..#10 Segment Basin.....	-127	-	0	0	0	0	322	-
..Urban.....	0	-	0	0	0	0	0	-
..Rural.....	-127	-	0	0	0	0	322	-
..Farm.....	-40	-	0	0	0	0	82	-
..Non-Farm.....	-87	-	0	0	0	0	240	-

(con't) Exhibit A-2.1t-County and Sub-Area "Between Year" Changes in Population Trends and Projections

Area Breakdown	Population Trends				Population Projections			
	1960-70		1970-75		1975-80		1980-95	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
..#11 Segment Basin.....	-17	-	0	0	0	0	44	-
..Urban.....	0	-	0	0	0	0	0	-
..Rural.....	-17	-	0	0	0	0	44	-
..Farm.....	-6	-	0	0	0	0	11	-
..Non-Farm.....	-11	-	0	0	0	0	33	-
CHRISTIAN COUNTY TOTAL.....	-680	-1.20	4,338	7.72	4,338	7.16	22,550	34.74
..Urban.....	15,401	79.12	4,499	12.9	2,820	7.16	14,658	34.75
..Rural.....	-16,081	-42.95	-161	-.75	1,518	7.16	7,892	34.74
..Farm.....	-4,825	-42.95	-48	-.75	455	7.16	2,368	34.75
..Non-Farm.....	-11,256	-42.95	-113	-.76	63	.42	5,524	34.74
..Outside LCRB.....	-5,789	-42.95	-58	-.75	546	7.16	2,842	34.75
..Urban.....	0	0	0	0	0	0	0	0
..Rural.....	-5,789	-42.95	-58	-.75	546	7.16	2,842	34.75
..Farm.....	-1,736	-42.94	-18	-.78	164	7.16	853	34.77
..Non-Farm.....	-4,053	-42.96	-40	-.74	382	7.15	1,989	34.75
..Inside LCRB.....	5,109	11.76	4,396	9.06	3,792	7.16	19,708	34.74
..Urban.....	15,371	78.97	4,499	12.9	2,820	7.16	14,658	34.75
..Rural.....	-10,262	-42.83	-103	-.75	972	7.16	5,050	34.74
..Farm.....	-3,087	-42.95	-31	-.75	291	7.15	1,515	34.74
..Non-Farm.....	-7,175	-42.78	-72	-.75	681	7.17	3,535	34.74
..#9 Segment Basin.....	-689	-	-7	-	65	-	338	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-689	-	-7	-	65	-	338	-
..Farm.....	-207	-	-2	-	19	-	102	-
..Non-Farm.....	-482	-	-5	-	46	-	236	-
..#10 Segment Basin.....	-2,553	-	-26	-	241	-	1,253	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-2,553	-	-26	-	241	-	1,253	-
..Farm.....	-766	-	-8	-	73	-	375	-
..Non-Farm.....	-1,787	-	-18	-	168	-	878	-
..#11 Segment Basin.....	-1,935	-	-20	-	183	-	949	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-1,935	-	-20	-	183	-	949	-
..Farm.....	-581	-	-6	-	55	-	285	-
..Non-Farm.....	-1,354	-	-14	-	128	-	664	-
..#12 Segment Basin.....	-1,101	-	-11	-	104	-	540	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-1,101	-	-11	-	104	-	540	-
..Farm.....	-330	-	-3	-	31	-	162	-
..Non-Farm.....	-771	-	-8	-	73	-	378	-
..#13 Segment Basin.....	7,924	-	2,685	-	1,817	-	9,441	-
..Urban.....	9,241	-	2,699	-	1,692	-	8,795	-
..Rural.....	-1,317	-	-14	-	125	-	646	-
..Farm.....	-395	-	-4	-	37	-	194	-
..Non-Farm.....	-922	-	-10	-	88	-	452	-
..#14 Segment Basin.....	4,699	-	1,785	-	1,266	-	6,581	-
..Urban.....	6,160	-	1,800	-	1,128	-	5,863	-
..Rural.....	-1,461	-	-15	-	138	-	718	-
..Farm.....	-439	-	-4	-	41	-	216	-
..Non-Farm.....	-1,022	-	-11	-	97	-	502	-

(con't) Exhibit A-2.1t-County and Sub-Area "Between Year" Changes in Population Trends and Projections

Area Breakdown	Population Trends				Population Projections			
	1960-70		1970-75		1975-80		1980-95	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
..#15 Segment Basin.....	-442	-	-4	-	40	-	207	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-422	-	-4	-	40	-	207	-
..Farm.....	-127	-	-1	-	12	-	62	-
..Non-Farm.....	-295	-	-3	-	28	-	145	-
..#16 Segment Basin.....	-720	-	-7	-	68	-	353	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-720	-	-7	-	68	-	353	-
..Farm.....	-216	-	-2	-	20	-	106	-
..Non-Farm.....	-504	-	-5	-	48	-	247	-
..#17 Segment Basin.....	-62	-	-1	-	6	-	31	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-62	-	-1	-	6	-	31	-
..Farm.....	-18	-	-1	-	2	-	9	-
..Non-Farm.....	-44	-	0	-	4	-	22	-
..#18 Segment Basin.....	-31	-	0	-	3	-	15	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-31	-	0	-	3	-	15	-
..Farm.....	-10	-	0	-	1	-	5	-
..Non-Farm.....	-21	-	0	-	2	-	10	-
TODD COUNTY TOTAL.....	-541	-4.76	0	0	0	0	477	4.41
..Urban.....	0	0	0	0	0	0	0	0
..Rural.....	-541	-4.76	0	0	0	0	477	4.41
..Farm.....	-178	-4.75	0	0	0	0	157	4.4
..Non-Farm.....	-363	-4.77	0	0	0	0	320	4.41
..Outside LCRB.....	-189	-4.75	0	0	0	0	167	4.41
..Urban.....	0	0	0	0	0	0	0	0
..Rural.....	-189	-4.75	0	0	0	0	167	4.41
..Farm.....	-62	-4.73	0	0	0	0	55	4.4
..Non-Farm.....	-127	-4.76	0	0	0	0	112	4.41
..Inside LCRB.....	-352	-4.76	0	0	0	0	310	4.41
..Urban.....	0	0	0	0	0	0	0	0
..Rural.....	-352	-4.76	0	0	0	0	310	4.41
..Farm.....	-116	-4.76	0	0	0	0	102	4.39
..Non-Farm.....	-236	-4.77	0	0	0	0	208	4.41
..#14 Segment Basin.....	-2	-	0	-	0	-	2	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-2	-	0	-	0	-	2	-
..Farm.....	-1	-	0	-	0	-	1	-
..Non-Farm.....	-1	-	0	-	0	-	1	-
..#15 Segment Basin.....	-1	-	0	-	0	-	1	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-1	-	0	-	0	-	1	-
..Farm.....	-1	-	0	-	0	-	1	-
..Non-Farm.....	0	-	0	-	0	-	0	-
..#16 Segment Basin.....	-1	-	0	-	0	-	1	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-1	-	0	-	0	-	1	-
..Farm.....	-1	-	0	-	0	-	1	-
..Non-Farm.....	0	-	0	-	0	-	0	-

(con't) Exhibit A-2.1t-County and Sub-Area "Between Year" Changes in Population Trends and Projections

Area Breakdown	Population Trends				Population Projections			
	1960-70		1970-75		1975-80		1980-95	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
..#17 Segment Basin.....	-103	-	0	-	0	-	94	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-103	-	0	-	0	-	94	-
..Farm.....	-34	-	0	-	0	-	31	-
..Non-Farm.....	-69	-	0	-	0	-	63	-
..#18 Segment Basin.....	-70	-	0	-	0	-	58	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-70	-	0	-	0	-	58	-
..Farm.....	-22	-	0	-	0	-	19	-
..Non-Farm.....	-48	-	0	-	0	-	39	-
..#19 Segment Basin.....	-119	-	0	-	0	-	105	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-119	-	0	-	0	-	105	-
..Farm.....	-39	-	0	-	0	-	35	-
..Non-Farm.....	-80	-	0	-	0	-	70	-
..#20 Segment Basin.....	-56	-	0	-	0	-	49	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-56	-	0	-	0	-	49	-
..Farm.....	-18	-	0	-	0	-	16	-
..Non-Farm.....	-38	-	0	-	0	-	33	-
LOGAN COUNTY TOTAL.....	897	4.29	1,253	5.75	1,254	5.44	5,950	24.48
..Urban (Russellville).....	595	10.15	8	.12	347	5.36	1,674	24.58
..Rural.....	302	2.01	1,245	8.12	907	5.47	4,276	24.45
..Farm.....	139	2.01	573	8.12	417	5.47	1,967	24.45
..Non-Farm.....	163	2.01	672	8.11	490	5.47	2,309	24.45
..Outside LCRB.....	657	4.68	782	5.32	843	5.44	3,998	24.48
..Urban.....	482	9.05	60	1.03	319	5.43	1,515	24.48
..Rural.....	175	2.01	722	8.12	524	5.45	2,483	24.48
..Farm.....	81	2.02	332	8.11	241	5.45	1,142	24.48
..Non-Farm.....	94	1.99	390	8.12	283	5.45	1,341	24.49
..Inside LCRB.....	240	3.5	471	6.64	411	5.44	1,952	24.5
..Urban.....	113	21.2	-56	-8.67	32	5.42	152	24.4
..Rural.....	127	2.01	527	8.18	379	5.44	1,800	24.5
..Farm.....	58	2.0	243	8.2	174	5.43	828	24.5
..Non-Farm.....	69	2.02	284	8.16	205	5.45	972	24.5
..#19 Segment Basin.....	14	-	53	-	38	-	182	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	14	-	53	-	38	-	182	-
..Farm.....	7	-	24	-	17	-	84	-
..Non-Farm.....	7	-	29	-	21	-	98	-
..#20 Segment Basin.....	227	-	411	-	367	-	1,747	-
..Urban.....	113	-	-56	-	32	-	152	-
..Rural.....	114	-	467	-	335	-	1,595	-
..Farm.....	53	-	214	-	155	-	733	-
..Non-Farm.....	61	-	253	-	180	-	862	-
..#21 Segment Basin.....	0	-	7	-	5	-	23	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	0	-	7	-	5	-	23	-
..Farm.....	0	-	3	-	2	-	11	-
..Non-Farm.....	0	-	4	-	3	-	12	-

(con't) Exhibit A-2.1t-County and Sub-Area "Between Year" Changes in Population Trends and Projections

Area Breakdown	Population Trends				Population Projections			
	1960-70		1970-75		1975-80		1980-95	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
SIMPSON COUNTY TOTAL.....	1,506	13.04	723	5.54	723	5.25	3,400	23.45
..Urban (Franklin).....	1,234	23.2	-216	-3.3	333	5.25	1,564	23.45
..Rural.....	272	4.37	939	14.44	390	5.24	1,836	23.45
..Farm.....	177	4.37	610	14.43	254	5.25	1,193	23.44
..Non-Farm.....	95	4.36	329	14.46	136	5.22	643	23.47
..Outside LCRB.....	1,423	14.78	438	3.96	603	5.25	2,836	23.45
..Urban.....	1,234	23.19	-216	-3.3	333	5.25	1,564	23.45
..Rural.....	189	4.38	654	14.54	270	5.24	1,272	23.46
..Farm.....	122	4.35	425	14.53	176	5.25	827	23.46
..Non-Farm.....	67	4.44	229	14.54	94	5.2	445	23.44
..Inside LCRB.....	83	4.32	285	14.24	120	5.25	564	23.43
..Urban.....	0	0	0	0	0	0	0	0
..Rural.....	83	4.32	285	14.24	120	5.25	564	23.43
..Farm.....	54	4.33	186	14.3	78	5.24	366	23.39
..Non-Farm.....	29	4.32	99	14.12	42	5.25	198	23.52
..#20 Segment Basin.....	82	-	282	-	118	-	558	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	82	-	282	-	118	-	558	-
..Farm.....	53	-	183	-	77	-	363	-
..Non-Farm.....	29	-	99	-	41	-	195	-
..#22 Segment Basin.....	1	-	3	-	2	-	6	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	1	-	3	-	2	-	6	-
..Farm.....	0	-	2	-	2	-	3	-
..Non-Farm.....	1	-	1	-	0	-	3	-

Exhibit A-2.2t-County and Sub-Area Past and Projected Population Density (1960-1995)

Area Breakdown	Trends, Persons/Sq. Mile		Projections, Persons/Sq. Mile		
	1960	1970	1975	1980	1995
STATE OF KENTUCKY	75.21	79.70	83.94	88.18	105.81
NINE-COUNTY TOTAL*.....	38.88	39.18	41.30	43.43	54.40
..Outside LCRB.....	34.40	32.42	33.50	35.04	42.74
..Inside LCRB.....	42.51	44.61	47.60	50.20	63.80
LIVINGSTON COUNTY TOTAL.....	20.55	22.21	22.95	23.68	27.20
..Outside LCRB.....	20.66	22.33	23.07	23.81	27.34
..North of LCRB.....	20.77	22.45	23.20	23.90	27.48
..South of LCRB.....	20.42	22.06	22.80	23.52	27.00
..Inside LCRB.....	20.38	22.02	22.76	23.49	26.97
..#1 Segment Basin.....	20.58	22.25	22.98	23.73	27.24
..#2 Segment Basin.....	19.97	21.60	22.30	23.00	26.40
..#4 Segment Basin.....	20.17	21.78	22.52	23.26	26.70
..#5 Segment Basin.....	23.30	25.00	25.80	26.70	30.80
CRITTENDEN COUNTY TOTAL.....	23.00	22.60	23.40	24.20	28.20
..Outside LCRB.....	22.95	24.92	25.88	26.84	31.52
..Inside LCRB.....	23.18	14.70	15.00	15.30	17.00
..#1 Segment Basin.....	23.25	14.74	15.02	15.30	17.00

*Urban and rural density breakdowns are not included because of unavailability of reasonably accurate urban land area and population figures.

(con't) Exhibit A-2.2-County and Sub-Area Past and Projected Population Density (1960-1995)

Area Breakdown	Trends, Persons/Sq. Mile		Projections, Persons/Sq. Mile		
	1960	1970	1975	1980	1995
..#2 Segment Basin.....	25.00	15.62	16.00	16.25	18.12
..#3 Segment Basin.....	22.94	14.56	14.84	15.11	16.78
LYON COUNTY TOTAL.....	22.52	21.15	22.00	22.81	27.00
..Outside LCRB.....	0	0	0	0	0
..Inside LCRB.....	25.87	24.30	25.24	26.20	31.00
..#3 Segment Basin.....	46.40	43.72	45.02	46.95	55.65
..#4 Segment Basin.....	50.00	47.00	48.40	50.50	59.80
..#5 Segment Basin.....	12.20	11.36	12.08	12.39	14.60
..#6 Segment Basin.....	46.80	44.00	45.38	47.25	56.12
..#7 Segment Basin.....	41.66	39.20	40.33	42.00	49.83
..#8 Segment Basin.....	44.57	42.00	43.21	45.10	53.43
CALDWELL COUNTY TOTAL.....	36.62	36.92	39.18	41.46	52.20
..Outside LCRB.....	23.85	22.60	23.40	24.20	28.17
..Inside LCRB.....	52.63	54.88	58.93	63.12	82.30
..#3 Segment Basin.....	20.91	19.30	19.82	20.23	22.73
..#5 Segment Basin.....	21.02	19.40	20.00	20.40	23.00

(con't) Exhibit A-2.2t-County and Sub-Area Past and Projected Population Density (1960-1995)

Area Breakdown	Trends, Persons/Sq. Mile		Projections, Persons/Sq. Mile		
	1960	1970	1975	1980	1995
..#8 Segment Basin.....	99.50	107.42	116.64	126.42	170.23
..#9 Segment Basin.....	20.80	19.16	19.70	20.10	22.60
TRIGG COUNTY TOTAL.....	18.95	18.42	18.42	18.42	19.76
..Outside LCRB.....	0	0	0	0	0
..Inside LCRB.....	20.80	20.20	20.20	20.20	21.66
..#5 Segment Basin.....	9.52	9.24	9.24	9.24	9.92
..#8 Segment Basin.....	168.00	162.66	162.66	162.66	174.66
..#9 Segment Basin.....	27.52	26.73	26.73	26.73	28.70
..#10 Segment Basin.....	27.07	26.31	26.31	26.31	28.23
..#11 Segment Basin.....	209.66	204.00	204.00	204.00	218.66
CHRISTIAN COUNTY TOTAL.....	78.38	77.44	83.42	89.40	120.45
..Outside LCRB.....	51.84	29.57	29.35	31.45	42.38
..Inside LCRB.....	93.20	104.15	113.58	121.72	164.00
..#9 Segment Basin.....	51.44	29.36	29.13	31.22	42.05
..#10 Segment Basin.....	51.23	29.22	29.00	31.10	41.88
..#11 Segment Basin.....	51.19	29.20	28.98	31.06	41.84

(con't) Exhibit A-2.2t-County and Sub-Area Past and Projected Population Density (1960-1995)

Area Breakdown	Trends, Persons/Sq. Mile		Projections, Persons/Sq. Mile		
	1960	1970	1975	1980	1995
..#12 Segment Basin.....	51.28	29.26	29.04	31.12	41.92
..#13 Segment Basin.....	245.77	377.83	422.58	452.87	610.22
..#14 Segment Basin.....	169.52	240.71	267.76	286.94	386.65
..#15 Segment Basin.....	51.68	29.47	29.26	31.37	42.26
..#16 Segment Basin.....	53.75	30.67	30.45	32.63	43.94
..#17 Segment Basin.....	48.00	27.30	27.00	29.00	39.30
..#18 Segment Basin.....	45.00	25.62	25.62	27.50	36.88
TODD COUNTY TOTAL.....	30.22	28.79	28.78	28.78	30.05
..Outside LCRB.....	30.27	28.83	28.83	28.83	30.10
..Inside LCRB.....	30.20	28.75	28.75	28.75	30.03
..#14 Segment Basin.....	28.13	26.88	26.88	26.88	28.13
..#15 Segment Basin.....	28.75	27.50	27.50	27.50	28.75
..#16 Segment Basin.....	28.75	27.50	27.50	27.50	28.75
..#17 Segment Basin.....	29.70	28.30	28.30	28.30	29.55
..#18 Segment Basin.....	31.15	29.70	29.70	29.70	30.90
..#19 Segment Basin.....	30.21	28.76	28.76	28.76	30.04

(con't) Exhibit A-2.2t-County and Sub-Area Past and Projected Population Density (1960-1995)

Area Breakdown	Trends, Persons/Sq. Mile		Projections, Persons/Sq. Mile		
	1960	1970	1975	1980	1995
..#20 Segment Basin.....	30.15	28.72	28.72	28.72	29.97
LOGAN COUNTY TOTAL.....	37.12	38.71	40.93	43.16	53.73
..Outside LCRB.....	43.22	45.25	47.65	50.25	62.55
..Inside LCRB.....	28.77	29.78	31.76	33.49	41.69
..#19 Segment Basin.....	26.54	27.12	29.30	30.92	38.50
..#20 Segment Basin.....	29.03	30.11	32.06	33.80	42.08
..#21 Segment.....	28.00	28.00	30.30	32.00	39.60
SIMPSON COUNTY TOTAL.....	48.32	54.62	57.64	60.67	74.90
..Outside LCRB.....	58.25	66.86	69.51	73.16	90.31
..Inside LCRB.....	26.04	27.16	31.03	32.66	40.31
..#20 Segment Basin.....	26.04	27.16	31.03	32.65	40.30
..#22 Segment Basin.....	26.25	27.50	31.25	33.75	41.25

Exhibit A-2.3t-Basin and Sub-Basin "At-Year" Population Trends and Projections (1960-1995)

Basin Breakdown	1960	1970	1975	1980	1995
STATE OF KENTUCKY	3,038,156	3,219,311	3,390,705	3,562,100	4,274,150
NINE-COUNTY TOTAL.....	144,255	145,344	153,242	161,143	201,781
..Urban.....	36,263	57,175	62,278	66,647	88,343
..Rural.....	107,992	88,169	90,964	94,496	113,438
..Farm.....	40,791	35,232	36,713	38,168	45,752
..Non-Farm.....	67,201	52,937	54,251	56,328	67,686
..Outside LCRB.....	56,815	53,586	55,347	57,921	70,644
..Urban.....	11,209	16,000	16,103	17,020	21,271
..Rural.....	45,606	37,586	39,244	40,901	49,373
..Farm.....	18,845	16,681	17,596	18,348	22,096
..Non-Farm.....	26,761	20,905	21,648	22,553	27,277
..Inside LCRB.....	87,440	91,758	97,895	103,222	131,137
..Urban.....	25,054	41,175	46,175	49,627	67,084
..Rural.....	62,386	50,583	51,720	53,595	64,053
..Farm.....	21,946	18,551	19,117	19,820	23,652
..Non-Farm.....	40,440	32,032	32,603	33,775	40,401
..#1 Segment Basin.....	2,620	2,352	2,420	2,489	2,831
..Urban.....	0	0	0	0	0
..Rural.....	2,620	2,352	2,420	2,489	2,831
..Farm.....	1,512	1,491	1,537	1,584	1,810
..Non-Farm.....	1,108	861	883	905	1,021
..Livingston County.....	1,546	1,671	1,726	1,782	2,046
..Urban.....	0	0	0	0	0
..Rural.....	1,546	1,671	1,726	1,782	2,046
..Farm.....	1,190	1,287	1,329	1,372	1,575
..Non-Farm.....	356	384	397	410	471
..Crittenden County.....	1,074	681	694	707	785
..Urban.....	0	0	0	0	0
..Rural.....	1,074	681	694	707	785
..Farm.....	322	204	208	212	235
..Non-Farm.....	752	477	486	495	550
..#2 Segment Basin.....	783	810	836	862	988
..Urban.....	0	0	0	0	0
..Rural.....	783	810	836	862	988
..Farm.....	565	600	600	601	694
..Non-Farm.....	218	210	236	261	294
..Livingston County.....	703	760	785	810	930
..Urban.....	0	0	0	0	0
..Rural.....	703	760	785	810	930
..Farm.....	541	585	585	585	677
..Non-Farm.....	162	175	200	225	253
..Crittenden County.....	80	50	51	52	58
..Urban.....	0	0	0	0	0
..Rural.....	80	50	51	52	58
..Farm.....	24	15	15	16	17
..Non-Farm.....	56	35	36	36	41
..#3 Segment Basin.....	3,290	2,834	2,912	3,014	3,504
..Urban.....	0	0	0	0	0
..Rural.....	3,290	2,834	2,912	3,014	3,504
..Farm.....	863	735	752	778	900
..Non-Farm.....	2,427	2,099	2,160	2,236	2,604

(con't) Exhibit A-2.3t-Basin and Sub-Basin "At-Year" Population Trends and Projections (1960-95)

Basin Breakdown	1960	1970	1975	1980	1995
..Caldwell County.....	460	424	436	445	500
..Urban.....	0	0	0	0	0
..Rural.....	460	424	436	445	500
..Farm.....	152	140	144	147	165
..Non-Farm.....	308	284	292	298	335
..Crittenden County.....	835	530	540	550	611
..Urban.....	0	0	0	0	0
..Rural.....	835	530	540	550	611
..Farm.....	250	160	162	165	183
..Non-Farm.....	585	370	378	385	428
..Lyon County.....	1,995	1,880	1,936	2,019	2,393
..Urban.....	0	0	0	0	0
..Rural.....	1,995	1,880	1,936	2,019	2,393
..Farm.....	461	435	446	466	552
..Non-Farm.....	1,534	1,445	1,490	1,553	1,841
..#4 Segment Basin.....	1,462	1,441	1,486	1,545	1,810
..Urban.....	0	0	0	0	0
..Rural.....	1,462	1,441	1,486	1,545	1,810
..Farm.....	587	603	622	645	749
..Non-Farm.....	875	838	864	900	1,061
..Livingston County.....	464	501	518	535	614
..Urban.....	0	0	0	0	0
..Rural.....	464	501	518	535	614
..Farm.....	357	386	399	412	473
..Non-Farm.....	107	115	119	123	141
..Lyon County.....	998	940	968	1,010	1,196
..Urban.....	0	0	0	0	0
..Rural.....	998	940	968	1,010	1,196
..Farm.....	230	217	223	233	276
..Non-Farm.....	768	723	745	777	920
..#5 Segment Basin.....	4,030	3,826	3,940	3,994	4,493
..Urban.....	0	0	0	0	0
..Rural.....	4,030	3,826	3,940	3,994	4,493
..Farm.....	1,330	1,264	1,303	1,321	1,520
..Non-Farm.....	2,700	2,562	2,637	2,673	2,973
..Livingston County.....	28	30	31	32	37
..Urban.....	0	0	0	0	0
..Rural.....	28	30	31	32	37
..Farm.....	22	23	24	25	28
..Non-Farm.....	6	7	7	7	9
..Lyon County.....	1,683	1,567	1,667	1,710	2,015
..Urban.....	0	0	0	0	0
..Rural.....	1,683	1,567	1,667	1,710	2,015
..Farm.....	561	522	556	570	672
..Non-Farm.....	1,122	1,045	1,111	1,140	1,343
..Caldwell County.....	492	454	467	477	536
..Urban.....	0	0	0	0	0
..Rural.....	492	454	467	477	536
..Farm.....	162	150	154	157	177
..Non-Farm.....	330	304	313	320	359

(con't) Exhibit A-2.3t-Basin and Sub-Basin "At-Year" Population Trends and Projections (1960-1995)

Basin Breakdown	1960	1970	1975	1980	1995
..Trigg County.....	1,827	1,775	1,775	1,775	1,905
..Urban.....	0	0	0	0	0
..Rural.....	1,827	1,775	1,775	1,775	1,905
..Farm.....	585	569	569	569	643
..Non-Farm.....	1,242	1,206	1,206	1,206	1,262
..#6 Segment Basin.....	374	352	363	378	449
..Lyon County.....	374	352	363	378	449
..Urban.....	0	0	0	0	0
..Rural.....	374	352	363	378	449
..Farm.....	86	82	83	87	104
..Non-Farm.....	288	270	279	291	345
..#7 Segment Basin.....	250	235	242	252	299
..Lyon County.....	250	235	242	252	299
..Urban.....	0	0	0	0	0
..Rural.....	250	235	242	252	299
..Farm.....	58	54	56	58	69
..Non-Farm.....	192	181	186	194	230
..#8 Segment Basin.....	7,118	7,585	8,192	8,844	11,774
..Urban.....	5,056	5,663	6,220	6,820	9,467
..Rural.....	2,062	1,922	1,972	2,024	2,307
..Farm.....	617	575	588	604	685
..Non-Farm.....	1,445	1,347	1,384	1,420	1,622
..Lyon County.....	624	588	605	631	748
..Urban.....	0	0	0	0	0
..Rural.....	624	588	605	631	748
..Farm.....	144	136	138	146	173
..Non-Farm.....	480	452	467	485	575
..Caldwell County.....	6,368	6,875	7,465	8,091	10,895
..Urban.....	5,056	5,663	6,220	6,820	9,467
..Rural.....	1,312	1,212	1,245	1,271	1,428
..Farm.....	433	400	411	419	471
..Non-Farm.....	879	812	834	852	957
..Trigg County.....	126	122	122	122	131
..Urban.....	0	0	0	0	0
..Rural.....	126	122	122	122	131
..Farm.....	40	39	39	39	41
..Non-Farm.....	86	83	83	83	90
..#9 Segment Basin.....	4,383	3,566	3,585	3,670	4,254
..Urban.....	0	0	0	0	0
..Rural.....	4,383	3,566	3,585	3,670	4,254
..Farm.....	1,381	1,131	1,137	1,163	1,338
..Non-Farm.....	3,002	2,435	2,175	2,507	2,916
..Caldwell County.....	1,017	939	965	985	1,106
..Urban.....	0	0	0	0	0
..Rural.....	1,017	939	965	985	1,106
..Farm.....	336	310	318	325	365
..Non-Farm.....	681	629	647	660	741
..Trigg County.....	1,761	1,711	1,711	1,711	1,836
..Urban.....	0	0	0	0	0
..Rural.....	1,761	1,711	1,711	1,711	1,836
..Farm.....	563	546	546	546	579
..Non-Farm.....	1,198	1,165	1,165	1,165	1,275

(con't) Exhibit A-2.3t-Basin and Sub-Basin "At-Year" Population Trends and Projections (1960-1995)

Basin Breakdown	1960	1970	1975	1980	1995
..Christian County.....	1,605	916	909	974	1,312
..Urban.....	0	0	0	0	0
..Rural.....	1,605	916	909	974	1,312
..Farm.....	482	275	273	292	394
..Non-Farm.....	1,123	641	636	682	918
..#10 Segment Basin.....	10,470	7,790	7,764	8,005	9,580
..Urban.....	0	0	0	0	0
..Rural.....	10,470	7,790	7,764	8,005	9,580
..Farm.....	3,231	2,425	2,417	2,490	2,947
..Non-Farm.....	7,239	5,365	5,347	5,515	6,633
..Trigg County.....	4,527	4,400	4,400	4,400	4,722
..Urban.....	0	0	0	0	0
..Rural.....	4,527	4,400	4,400	4,400	4,722
..Farm.....	1,448	1,408	1,408	1,408	1,490
..Non-Farm.....	3,079	2,992	2,992	2,992	3,232
..Christian County.....	5,943	3,390	3,364	3,605	4,858
..Urban.....	0	0	0	0	0
..Rural.....	5,943	3,390	3,364	3,605	4,858
..Farm.....	1,783	1,017	1,009	1,082	1,457
..Non-Farm.....	4,160	2,373	2,355	2,523	3,401
..#11 Segment Basin.....	5,134	3,182	3,162	3,345	4,338
..Urban.....	0	0	0	0	0
..Rural.....	5,134	3,182	3,162	3,345	4,338
..Farm.....	1,554	967	961	1,016	1,312
..Non-Farm.....	3,580	2,215	2,201	2,329	3,026
..Trigg County.....	629	612	612	612	656
..Urban.....	0	0	0	0	0
..Rural.....	629	612	612	612	656
..Farm.....	202	196	196	196	207
..Non-Farm.....	427	416	416	416	449
..Christian County.....	4,505	2,570	2,550	2,733	3,682
..Urban.....	0	0	0	0	0
..Rural.....	4,505	2,570	2,550	2,733	3,682
..Farm.....	1,352	771	765	820	1,105
..Non-Farm.....	3,153	1,799	1,785	1,913	2,577
..#12 Segment Basin.....	2,564	1,463	1,452	1,556	2,096
..Christian County.....	2,564	1,463	1,452	1,556	2,096
..Urban.....	0	0	0	0	0
..Rural.....	2,564	1,463	1,452	1,556	2,096
..Farm.....	769	439	436	467	629
..Non-Farm.....	1,795	1,024	1,016	1,089	1,467
..#13 Segment Basin.....	14,746	22,670	25,355	27,172	36,613
..Christian County.....	14,746	22,670	25,355	27,172	36,613
..Urban.....	11,679	20,920	23,619	25,311	34,106
..Rural.....	3,067	1,750	1,736	1,861	2,507
..Farm.....	920	525	521	558	752
..Non-Farm.....	2,147	1,225	1,215	1,303	1,755
..#14 Segment Basin.....	11,233	15,930	17,715	18,981	25,564
..Urban.....	7,786	13,946	15,746	16,874	22,737
..Rural.....	3,447	1,984	1,969	2,107	2,827
..Farm.....	1,036	596	592	633	850
..Non-Farm.....	2,411	1,388	1,377	1,474	1,977

(con't) Exhibit A-2.3t-Basin and Sub-Basin "At-Year" Population Trends and Projections (1960-1995)

Basin Breakdown	1960	1970	1975	1980	1995
..Christian County.....	11,188	15,887	17,672	18,938	25,519
..Urban.....	7,786	13,946	15,746	16,874	22,737
..Rural.....	3,402	1,941	1,926	2,064	2,782
..Farm.....	1,021	582	578	619	835
..Non-Farm.....	2,381	1,359	1,348	1,445	1,947
..Todd County.....	45	43	43	43	45
..Urban.....	0	0	0	0	0
..Rural.....	45	43	43	43	45
..Farm.....	15	14	14	14	15
..Non-Farm.....	30	29	29	29	30
..#15 Segment Basin.....	1,005	582	578	618	826
..Urban.....	0	0	0	0	0
..Rural.....	1,005	582	578	618	826
..Farm.....	303	175	174	186	249
..Non-Farm.....	702	407	404	432	577
..Christian County.....	982	560	556	596	803
..Urban.....	0	0	0	0	0
..Rural.....	982	560	556	596	803
..Farm.....	295	168	167	179	241
..Non-Farm.....	687	392	389	417	562
..Todd County.....	23	22	22	22	23
..Urban.....	0	0	0	0	0
..Rural.....	23	22	22	22	23
..Farm.....	8	7	7	7	8
..Non-Farm.....	15	15	15	15	15
..#16 Segment Basin.....	1,700	979	972	1,040	1,394
..Urban.....	0	0	0	0	0
..Rural.....	1,700	979	972	1,040	1,394
..Farm.....	511	294	292	312	419
..Non-Farm.....	1,189	685	680	728	975
..Christian County.....	1,677	957	950	1,018	1,371
..Urban.....	0	0	0	0	0
..Rural.....	1,677	957	950	1,018	1,371
..Farm.....	503	287	285	305	411
..Non-Farm.....	1,174	670	665	713	960
..Todd County.....	23	22	22	22	23
..Urban.....	0	0	0	0	0
..Rural.....	23	22	22	22	23
..Farm.....	8	7	7	7	8
..Non-Farm.....	15	15	15	15	15
..#17 Segment Basin.....	2,303	2,138	2,137	2,143	2,268
..Urban.....	0	0	0	0	0
..Rural.....	2,303	2,138	2,137	2,143	2,268
..Farm.....	770	718	717	719	759
..Non-Farm.....	1,533	1,420	1,420	1,424	1,509
..Christian County.....	144	82	81	87	118
..Urban.....	0	0	0	0	0
..Rural.....	144	82	81	87	118
..Farm.....	43	25	24	26	35
..Non-Farm.....	101	57	57	61	83

(con't) Exhibit A-2.3t-Basin and Sub-Basin "At-Year" Population Trends and Projections (1960-1995)

Basin Breakdown	1960	1970	1975	1980	1995
..Todd County.....	2,159	2,056	2,056	2,056	2,150
..Urban.....	0	0	0	0	0
..Rural.....	2,159	2,056	2,056	2,056	2,150
..Farm.....	727	693	693	693	724
..Non-Farm.....	1,432	1,363	1,363	1,363	1,426
..#18 Segment Basin.....	1,550	1,449	1,449	1,452	1,525
..Urban.....	0	0	0	0	0
..Rural.....	1,550	1,449	1,449	1,452	1,525
..Farm.....	495	463	463	464	488
..Non-Farm.....	1,055	986	986	988	1,037
..Christian County.....	72	41	41	44	59
..Urban.....	0	0	0	0	0
..Rural.....	72	41	41	44	59
..Farm.....	22	12	12	13	18
..Non-Farm.....	50	29	29	31	41
..Todd County.....	1,478	1,408	1,408	1,408	1,466
..Urban.....	0	0	0	0	0
..Rural.....	1,478	1,408	1,408	1,408	1,466
..Farm.....	473	451	451	451	470
..Non-Farm.....	1,005	957	957	957	996
..#19 Segment Basin.....	3,114	3,009	3,062	3,100	3,387
..Urban.....	0	0	0	0	0
..Rural.....	3,114	3,009	3,062	3,100	3,387
..Farm.....	1,110	1,078	1,102	1,119	1,238
..Non-Farm.....	2,004	1,931	1,960	1,981	2,149
..Todd County.....	2,477	2,358	2,358	2,358	2,463
..Urban.....	0	0	0	0	0
..Rural.....	2,477	2,358	2,358	2,358	2,463
..Farm.....	817	778	778	778	813
..Non-Farm.....	1,660	1,580	1,580	1,580	1,650
..Logan County.....	637	651	704	742	924
..Urban.....	0	0	0	0	0
..Rural.....	637	651	704	742	924
..Farm.....	293	300	324	341	425
..Non-Farm.....	344	351	380	401	499
..#20 Segment Basin.....	9,207	9,460	10,153	10,638	12,992
..Urban.....	533	646	590	622	774
..Rural.....	8,674	8,814	9,563	10,016	12,218
..Farm.....	4,197	4,285	4,682	4,914	6,026
..Non-Farm.....	4,477	4,529	4,881	5,102	6,192
..Todd County.....	1,182	1,126	1,126	1,126	1,175
..Urban.....	0	0	0	0	0
..Rural.....	1,182	1,126	1,126	1,126	1,175
..Farm.....	390	372	372	372	388
..Non-Farm.....	792	754	754	754	787
..Simpson County.....	1,898	1,980	2,262	2,380	2,938
..Urban.....	0	0	0	0	0
..Rural.....	1,898	1,980	2,262	2,380	2,938
..Farm.....	1,234	1,287	1,470	1,547	1,910
..Non-Farm.....	664	693	792	833	1,028

(con't) Exhibit A-2.3t-Basin and Sub-Basin "At-Year" Population Trends and Projections (1960-1995)

Basin Breakdown	1960	1970	1975	1980	1995
..Logan County.....	6,127	6,354	6,765	7,132	8,879
..Urban.....	533	646	590	622	774
..Rural.....	5,594	5,708	6,175	6,510	8,105
..Farm.....	2,573	2,626	2,840	2,995	3,728
..Non-Farm.....	3,021	3,082	3,335	3,515	4,377
..#21 Segment Basin.....	84	84	91	96	119
..Logan County.....	84	84	91	96	119
..Urban.....	0	0	0	0	0
..Rural.....	84	84	91	96	119
..Farm.....	39	39	42	44	55
..Non-Farm.....	45	45	49	52	64
..#22 Segment Basin.....	21	22	25	27	33
..Simpson County.....	21	22	25	27	33
..Urban.....	0	0	0	0	0
..Rural.....	21	22	25	27	33
..Farm.....	14	14	16	18	21
..Non-Farm.....	7	8	9	9	12

Exhibit A-2.4t-Basin & Sub-Basin "Between Year" Changes in Population Trends and Projections (1975-1995)

Basin Breakdown	Population Trends				Population Projections			
	1960-70		1970-75		1975-80		1980-95	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
STATE OF KENTUCKY*1	181,155	6.00	171,394	5.00	171,395	5.00	712,050	20.00
NINE-COUNTY TOTAL*2.....	1,089	.76	7,898	5.40	7,901	5.16	40,638	25.22
..Urban*3.....	20,912	57.66	5,103	8.92	4,369	7.02	21,696	32.55
..Rural*3.....	-19,823	-18.36	2,795	3.17	3,532	3.88	18,942	20.04
..Farm*3.....	-5,559	-13.63	1,481	4.20	1,455	3.96	7,584	19.87
..Non-Farm*3.....	-14,264	-21.22	1,314	2.48	2,077	3.83	11,358	20.16
..Outside LCRB*3.....	-3,229	-5.68	1,761	3.28	2,574	4.65	12,723	21.97
..Urban*3.....	4,791	42.74	103	.64	917	5.69	4,251	24.98
..Rural*3.....	-8,020	-17.58	1,658	4.41	1,657	4.22	8,472	20.75
..Farm*3.....	-2,164	-11.48	915	5.48	752	4.27	3,748	20.43
..Non-Farm*3.....	-5,856	-21.88	743	3.55	905	4.18	4,724	20.95
..Inside LCRB*3.....	4,318	4.94	6,137	6.69	5,327	5.44	27,915	27.04
..Urban*3.....	16,121	63.34	5,000	12.14	3,452	7.48	17,457	35.18
..Rural*3.....	-11,803	-18.92	1,137	2.25	1,875	3.62	10,458	19.51
..Farm*3.....	-3,395	-15.47	566	3.05	703	3.68	3,832	19.33
..Non-Farm*3.....	-8,408	-20.79	571	1.78	1,172	3.59	6,626	19.62
..#1 Segment Basin*3.....	-268	-10.23	68	2.89	69	2.85	342	13.74
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-268	-	68	-	69	-	342	-
..Farm.....	-21	-	46	-	47	-	226	-
..Non-Farm.....	-247	-	22	-	22	-	116	-
..Livingston County*3.....	125	-	55	-	56	-	264	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	125	-	55	-	56	-	264	-
..Farm.....	97	-	42	-	43	-	203	-
..Non-Farm.....	28	-	13	-	13	-	61	-
..Crittenden County*3.....	-393	-	13	-	13	-	78	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-393	-	13	-	13	-	78	-
..Farm.....	-118	-	4	-	4	-	23	-
..Non-Farm.....	-275	-	9	-	9	-	55	-
..#2 Segment Basin*3.....	27	3.45	26	3.21	26	3.11	126	14.62
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	27	-	26	-	26	-	126	-
..Farm.....	35	-	0	-	1	-	93	
..Non-Farm.....	-8	-	26	-	25	-	33	-
..Livingston County*3.....	57	-	25	-	25	-	120	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	57	-	25	-	25	-	120	-
..Farm.....	44	-	0	-	0	-	92	-
..Non-Farm.....	13	-	25	-	25	-	28	-
..Crittenden County*3.....	-30	-	1	-	1	-	6	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-30	-	1	-	1	-	6	-
..Farm.....	-9	-	0	-	1	-	1	-
..Non-Farm.....	-21	-	1	-	0	-	5	-
..#3 Segment Basin.....	-456	-13.86	78	2.75	102	3.50	490	16.26
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-456	-	78	-	102	-	490	-
..Farm.....	-128	-	17	-	26	-	122	-
..Non-Farm.....	-328	-	61	-	76	-	368	-

*1-Percentage shows Kentucky increase.
*2-Percentage shows nine-county increase.
*3-Percentage reads horizontally

(con't) Exhibit A-2.4t-Basin & Sub-Basin "Between-Year" Changes in Population Trends and Projections (1975-1995)

Basin Breakdown	Population Trends				Population Projections			
	1960-70		1970-75		1975-80		1980-95	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
..Caldwell County.....	-36	-	12	-	9	-	55	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-36	-	12	-	9	-	55	-
. Farm.....	-12	-	4	-	3	-	18	-
..Non-Farm.....	-24	-	8	-	6	-	37	-
..Crittenden County.....	-305	-	10	-	10	-	61	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-305	-	10	-	10	-	61	-
..Farm.....	-90	-	2	-	3	-	18	-
..Non-Farm.....	-215	-	8	-	7	-	43	-
..Lyon County.....	-115	-	56	-	83	-	374	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-115	-	56	-	83	-	374	-
..Farm.....	-26	-	11	-	20	-	86	-
..Non-Farm.....	-89	-	45	-	63	-	288	-
..#4 Segment Basin.....	-21	1.44	45	3.12	59	3.97	265	17.15
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-21	-	45	-	59	-	265	-
..Farm.....	16	-	19	-	23	-	104	-
..Non-Farm.....	-37	-	26	-	36	-	161	-
..Livingston County.....	37	-	17	-	17	-	79	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	37	-	17	-	17	-	79	-
..Farm.....	29	-	13	-	13	-	61	-
..Non-Farm.....	8	-	4	-	4	-	18	-
..Lyon County.....	-58	-	28	-	42	-	186	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-58	-	28	-	42	-	186	-
..Farm.....	-13	-	6	-	10	-	43	-
..Non-Farm.....	-45	-	22	-	32	-	143	-
..#5 Segment Basin.....	-204	-5.06	114	2.98	54	1.37	499	12.49
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-204	-	114	-	54	-	499	-
..Farm.....	-66	-	39	-	18	-	199	-
..Non-Farm.....	-138	-	75	-	36	-	300	-
..Livingston County.....	2	-	1	-	1	-	5	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	2	-	1	-	1	-	5	-
..Farm.....	1	-	1	-	1	-	3	-
..Non-Farm.....	1	-	0	-	0	-	2	-
..Lyon County.....	-116	-	100	-	43	-	305	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-116	-	100	-	43	-	305	-
..Farm.....	-39	-	34	-	14	-	102	-
..Non-Farm.....	-77	-	66	-	29	-	203	-
..Caldwell County.....	-38	-	13	-	10	-	59	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-38	-	13	-	10	-	59	-
..Farm.....	-12	-	4	-	3	-	20	-
..Non-Farm.....	-26	-	9	-	7	-	39	-

(con't) Exhibit A-2.4t-Basin & Sub-Basin "Between Year" Changes in Population Trends and Projections (1975-1995)

Basin Breakdown	Population Trends				Population Projections			
	1960-70		1970-75		1975-80		1980-95	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
..Trigg County.....	-52	-	0	-	0	-	130	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-52	-	0	-	0	-	130	-
..Farm.....	-16	-	0	-	0	-	74	-
..Non-Farm.....	-36	-	0	-	0	-	56	-
..#6 Segment Basin.....	-22	-5.88	11	3.12	15	4.13	71	18.78
..Lyon County.....	-22	-	11	-	15	-	71	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-22	-	11	-	15	-	71	-
..Farm.....	-4	-	2	-	3	-	17	-
..Non-Farm.....	-18	-	9	-	12	-	54	-
..#7 Segment Basin.....	-15	-6.00	7	-2.98	10	4.13	47	18.65
..Lyon County.....	-15	-	7	-	10	-	47	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-15	-	7	-	10	-	47	-
..Farm.....	-4	-	2	-	2	-	11	-
..Non-Farm.....	-11	-	5	-	8	-	36	-
..#8 Segment Basin.....	467	6.56	607	8.00	652	7.96	2,930	33.13
..Urban.....	607	-	557	-	600	-	2,647	-
..Rural.....	-140	-	50	-	52	-	283	-
..Farm.....	-42	-	13	-	16	-	81	-
..Non-Farm.....	-98	-	37	-	36	-	202	-
..Lyon County.....	-36	-	17	-	26	-	117	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-36	-	17	-	26	-	117	-
..Farm.....	-8	-	2	-	8	-	27	-
..Non-Farm.....	-28	-	15	-	18	-	90	-
..Caldwell County.....	507	-	590	-	626	-	2,804	-
..Urban.....	607	-	557	-	600	-	2,647	-
..Rural.....	-100	-	33	-	26	-	157	-
..Farm.....	-33	-	11	-	8	-	52	-
..Non-Farm.....	-67	-	22	-	18	-	105	-
..Trigg County.....	-4	-	0	-	0	-	9	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-4	-	0	-	0	-	9	-
..Farm.....	-1	-	0	-	0	-	2	-
..Non-Farm.....	-3	-	0	-	0	-	7	-
..#9 Segment Basin.....	-817	-18.64	19	.53	85	2.37	584	15.91
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-817	-	19	-	85	-	584	-
..Farm.....	-250	-	6	-	26	-	175	-
..Non-Farm.....	-567	-	13	-	59	-	409	-
..Caldwell County.....	-78	-	26	-	20	-	121	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-78	-	26	-	20	-	121	-
..Farm.....	-26	-	8	-	7	-	40	-
..Non-Farm.....	-52	-	18	-	13	-	81	-

(con't) Exhibit A-2.4t-Basin & Sub-Basin "Between-Year" Changes in Population Trends and Projections (1975-1995)

Basin Breakdown	Population Trends				Population Projections			
	1960-70		1970-75		1975-80		1980-95	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
..Trigg County.....	-50	-	0	-	0	-	125	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-50	-	0	-	0	-	125	-
..Farm.....	-17	-	0	-	0	-	33	-
..Non-Farm.....	-33	-	0	-	0	-	92	-
..Christian County.....	-689	-	-7	-	65	-	338	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-689	-	-7	-	65	-	338	-
..Farm.....	-207	-	-2	-	19	-	102	-
..Non-Farm.....	-482	-	-5	-	46	-	236	-
..#10 Segment Basin.....	-2,680	25.60	-26	-.33	241	3.10	1,575	19.68
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-2,680	-	-26	-	241	-	1,575	-
..Farm.....	-806	-	-8	-	73	-	457	-
..Non-Farm.....	-1,874	-	-18	-	168	-	1,118	-
..Trigg County.....	-127	-	0	-	0	-	322	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-127	-	0	-	0	-	322	-
..Farm.....	-40	-	0	-	0	-	82	-
..Non-Farm.....	-87	-	0	-	0	-	240	-
..Christian County.....	-2,553	-	-26	-	241	-	1,253	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-2,553	-	-26	-	241	-	1,253	-
..Farm.....	-766	-	-8	-	73	-	375	-
..Non-Farm.....	-1,787	-	-18	-	168	-	878	-
..#11 Segment Basin.....	-1,952	-38.02	-20	-.63	183	5.80	993	29.70
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-1,952	-	-20	-	183	-	993	-
..Farm.....	-587	-	-6	-	55	-	296	-
..Non-Farm.....	-1,365	-	-14	-	128	-	697	-
..Trigg County.....	-17	-	0	-	0	-	44	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-17	-	0	-	0	-	44	-
..Farm.....	-6	-	0	-	0	-	11	-
..Non-Farm.....	-11	-	0	-	0	-	33	-
..Christian County.....	-1,935	-	-20	-	183	-	949	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-1,935	-	-20	-	183	-	949	-
..Farm.....	-581	-	-6	-	55	-	285	-
..Non-Farm.....	-1,354	-	-14	-	128	-	664	-
..#12 Segment Basin.....	-1,101	-42.94	-11	-.75	104	7.16	540	34.70
..Christian County.....	-1,101	-	-11	-	104	-	540	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-1,101	-	-11	-	104	-	540	-
..Farm.....	-330	-	-3	-	31	-	162	-
..Non-Farm.....	-771	-	-8	-	73	-	378	-
..#13 Segment Basin.....	7,924	53.74	2,685	11.84	1,817	7.17	9,441	34.74
..Christian County.....	7,924	-	2,685	-	1,817	-	9,441	-
..Urban.....	9,241	-	2,699	-	1,692	-	8,795	-
..Rural.....	-1,317	-	-14	-	125	-	646	-
..Farm.....	-395	-	-4	-	37	-	194	-
..Non-Farm.....	-922	-	-10	-	88	-	452	-

(con't) Exhibit A-2.4t-Basin & Sub-Basin "Between-Year" Changes in Population Trends and Projections (1975-95)

Basin Breakdown	Population Trends				Population Projections			
	1960-70		1970-75		1975-80		1980-95	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
..#14 Segment Basin.....	4,697	41.81	1,785	11.20	1,266	7.15	6,583	34.68
..Urban.....	6,160	-	1,800	-	1,128	-	5,863	-
..Rural.....	-1,463	-	-15	-	138	-	720	-
..Farm.....	-440	-	-4	-	41	-	217	-
..Non-Farm.....	-1,023	-	-11	-	97	-	503	-
..Christian County.....	4,699	-	1,785	-	1,266	-	6,581	-
..Urban.....	6,160	-	1,800	-	1,128	-	5,863	-
..Rural.....	-1,461	-	-15	-	138	-	718	-
..Farm.....	-439	-	-4	-	41	-	216	-
..Non-Farm.....	-1,022	-	-11	-	97	-	502	-
..Todd County.....	-2	-	0	-	0	-	2	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-2	-	0	-	0	-	2	-
..Farm.....	-1	-	0	-	0	-	1	-
..Non-Farm.....	-1	-	0	-	0	-	1	-
..#15 Segment Basin.....	-423	-42.09	-4	-.68	39	6.75	208	33.66
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-423	-	-4	-	39	-	208	-
..Farm.....	-128	-	-1	-	12	-	63	-
..Non-Farm.....	-295	-	-3	-	27	-	145	-
..Christian County.....	-422	-	-4	-	40	-	207	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-422	-	-4	-	40	-	207	-
..Farm.....	-127	-	-1	-	12	-	62	-
..Non-Farm.....	-295	-	-3	-	28	-	145	-
..Todd County.....	-1	-	0	-	-1	-	1	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-1	-	0	-	-1	-	1	-
..Farm.....	-1	-	0	-	0	-	1	-
..Non-Farm.....	0	-	0	-	-1	-	0	-
..#16 Segment Basin.....	-721	-42.41	-7	-.72	68	7.00	354	34.04
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-721	-	-7	-	68	-	354	-
..Farm.....	-217	-	-2	-	20	-	107	-
..Non-Farm.....	-504	-	-5	-	48	-	247	-
..Christian County.....	-720	-	-7	-	68	-	353	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-720	-	-7	-	68	-	353	-
..Farm.....	-216	-	-2	-	20	-	106	-
..Non-Farm.....	-504	-	-5	-	48	-	247	
..Todd County.....	-1	-	0	-	0	-	1	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-1	-	0	-	0	-	1	-
..Farm.....	-1	-	0	-	0	-	1	-
..Non-Farm.....	0	-	0	-	0	-	0	-
..#17 Segment Basin.....	-165	-7.16	-1	-.05	6	.28	125	5.83
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-165	-	-1	-	6	-	125	-
..Farm.....	-52	-	-1	-	2	-	40	-
..Non-Farm.....	-113	-	0	-	4	-	85	-

(con't) Exhibit A-2.4t-Basin & Sub-Basin "Between Year" Changes in Population Trends and Projections (1975-1995)

Basin Breakdown	Population Trends				Population Projections			
	1960-70		1970-75		1975-80		1980-95	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
..Christian County.....	-62	-	-1	-	6	-	31	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-62	-	-1	-	6	-	31	-
..Farm.....	-18	-	-1	-	2	-	9	-
..Non-Farm.....	-44	-	0	-	4	-	22	-
..Todd County.....	-103	-	0	-	0	-	94	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-103	-	0	-	0	-	94	-
..Farm.....	-34	-	0	-	0	-	31	-
..Non-Farm.....	-69	-	0	-	0	-	63	-
..#18 Segment Basin.....	-101	-6.52	0	0	3	.21	73	5.03
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-101	-	0	-	3	-	73	-
..Farm.....	-32	-	0	-	1	-	24	-
..Non-Farm.....	-69	-	0	-	2	-	49	-
..Christian County.....	-31	-	0	-	3	-	15	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-31	-	0	-	3	-	15	-
..Farm.....	-10	-	0	-	1	-	5	-
..Non-Farm.....	-21	-	0	-	2	-	10	-
..Todd County.....	-70	-	0	-	0	-	58	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-70	-	0	-	0	-	58	-
..Farm.....	-22	-	0	-	0	-	19	-
..Non-Farm.....	-48	-	0	-	0	-	39	-
..#19 Segment Basin.....	-105	-3.37	53	1.76	38	1.24	287	9.26
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-105	-	53	-	38	-	287	-
..Farm.....	-32	-	24	-	17	-	119	-
..Non-Farm.....	-73	-	29	-	21	-	168	-
..Todd County.....	-119	-	0	-	0	-	105	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-119	-	0	-	0	-	105	-
..Farm.....	-39	-	0	-	0	-	35	-
..Non-Farm.....	-80	-	0	-	0	-	70	-
..Logan County.....	14	-	53	-	38	-	182	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	14	-	53	-	38	-	182	-
..Farm.....	7	-	24	-	17	-	84	-
..Non-Farm.....	7	-	29	-	21	-	98	-
..#20 Segment Basin.....	253	2.75	693	4.19	485	4.78	2,354	22.13
..Urban.....	113	-	-56	-	32	-	152	-
..Rural.....	140	-	746	-	453	-	2,202	-
..Farm.....	88	-	397	-	232	-	1,112	-
..Non-Farm.....	52	-	349	-	221	-	1,090	-
..Todd County.....	-56	-	0	-	0	-	49	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	-56	-	0	-	0	-	49	-
..Farm.....	-18	-	0	-	0	-	16	-
..Non-Farm.....	-38	-	0	-	0	-	33	-

(con't) Exhibit A-2.4t-Basin & Sub-Basin "Between-Year" Changes in Population Trends and Projections (1975-1995)

Basin Breakdown	Population Trends				Population Projections			
	1960-70		1970-75		1975-80		1980-95	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
..Simpson County.....	82	-	282	-	118	-	558	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	82	-	282	-	118	-	558	-
..Farm.....	53	-	182	-	77	-	363	-
..Non-Farm.....	29	-	99	-	41	-	195	-
..Logan County.....	227	-	411	-	367	-	1,747	-
..Urban.....	113	-	-56	-	32	-	152	-
..Rural.....	114	-	467	-	335	-	1,595	-
..Farm.....	53	-	214	-	155	-	733	-
..Non-Farm.....	61	-	253	-	180	-	862	-
..#21 Segment Basin.....	0	0	7	8.30	5	5.49	23	23.96
..Logan County.....	0	-	7	-	5	-	23	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	0	-	7	-	5	-	23	-
..Farm.....	0	-	3	-	2	-	11	-
..Non-Farm.....	0	-	4	-	3	-	12	-
..#22 Segment Basin.....	1	4.76	3	13.64	2	8.00	6	22.22
..Simpson County.....	1	-	3	-	2	-	6	-
..Urban.....	0	-	0	-	0	-	0	-
..Rural.....	1	-	3	-	2	-	6	-
..Farm.....	0	-	2	-	2	-	3	-
..Non-Farm.....	1	-	1	-	0	-	3	-

Exhibit A-2.5t-Basin and Sub-Basin Past and Projected Population Density (1960-1995)

Basin Breakdown	Trends, Persons/Sq. Mile		Projections, Persons/Sq. Mile		
	1960	1970	1975	1980	1995
LOWER CUMBERLAND TOTAL.....	42.51	44.61	47.60	51.18	63.75
..#1 Segment Basin.....	21.60	19.38	19.95	20.52	23.34
..Livingston County.....	20.58	22.25	22.98	23.73	27.24
..Crittendon County.....	23.25	14.74	15.02	15.30	17.00
..#2 Segment Basin.....	20.39	21.09	21.77	22.44	25.73
..Livingston County.....	19.97	21.60	22.30	23.00	26.40
..Crittendon County.....	25.00	15.62	16.00	16.25	18.12
..#3 Segment Basin.....	32.45	28.00	28.72	29.72	34.91
..Caldwell County.....	20.91	19.27	19.82	20.23	22.73
..Crittenden County.....	22.94	14.56	14.84	15.11	16.80
..Lyon County.....	46.40	43.72	45.02	47.00	55.65
..#4 Segment Basin.....	34.00	33.51	34.56	36.00	42.10
..Livingston County.....	20.17	21.78	22.52	23.26	26.70
..Lyon County.....	50.00	47.00	48.40	50.50	59.80
..#5 Segment Basin.....	11.36	10.79	11.11	11.26	12.67
..Livingston County.....	23.30	25.00	25.80	26.70	30.80
..Lyon County.....	12.20	11.36	12.08	12.39	14.60
..Caldwell County.....	21.03	19.40	20.00	20.40	22.91
..Trigg County.....	9.52	9.24	9.24	9.24	9.92

(con't) Exhibit A-2.5t-Basin and Sub-Basin Past and Projected Population Density (1960-1995)

Basin Breakdown	Trends, Persons/Sq. Mile		Projections, Persons/Sq. Mile		
	1960	1970	1975	1980	1995
..#6 Segment Basin.....	46.78	44.00	45.38	47.25	56.12
..Lyon County.....	46.78	44.00	45.38	47.25	56.12
..#7 Segment Basin.....	41.70	39.20	40.00	42.00	50.00
..Lyon County.....	41.70	39.20	40.00	42.00	50.00
..#8 Segment Basin.....	90.40	96.32	104.02	112.30	150.00
..Lyon County.....	44.60	42.00	43.21	45.07	53.43
..Caldwell County.....	100.00	107.42	116.64	126.42	170.23
..Trigg County.....	168.00	162.66	162.66	162.66	174.66
..#9 Segment Basin.....	30.40	24.73	24.86	25.45	30.00
..Caldwell County.....	20.80	19.20	19.70	20.10	22.60
..Trigg County.....	27.52	26.73	26.73	26.73	28.70
..Christian County.....	51.44	29.36	29.13	31.22	42.05
..#10 Segment Basin.....	36.96	28.00	27.41	28.26	33.82
..Trigg County.....	27.07	26.31	26.31	26.31	28.23
..Christian County.....	51.23	29.22	29.00	31.07	41.88
..#11 Segment Basin.....	56.42	35.00	34.75	36.76	47.70
..Trigg County.....	209.66	204.00	204.00	204.00	218.70
..Christian County.....	51.19	29.20	28.98	31.06	41.84
..#12 Segment Basin.....	51.28	29.26	29.04	31.12	41.92
..Christian County.....	51.28	29.26	29.04	31.12	41.92

(con't) Exhibit A-2.5t-Basin and Sub-Basin Past and Projected Population Density (1960-1995)

Basin Breakdown	Trends, Persons/Sq. Mile		Projections, Persons/Sq. Mile		
	1960	1970	1975	1980	1995
..#13 Segment Basin.....	245.77	377.83	422.58	452.87	610.22
..Christian County.....	245.77	377.83	422.58	452.87	610.22
..#14 Segment Basin.....	166.17	235.65	262.05	280.78	378.16
..Christian County.....	169.52	240.71	267.76	286.94	386.65
..Todd County.....	28.13	26.88	26.88	26.88	28.13
..#15 Segment Basin.....	50.75	29.39	29.19	31.16	41.72
..Christian County.....	51.68	29.47	29.26	31.37	42.26
..Todd County.....	28.75	27.50	27.50	27.50	28.75
..#16 Segment Basin.....	53.13	30.59	30.38	32.50	43.56
..Christian County.....	53.75	30.67	30.45	32.63	43.94
..Todd County.....	28.75	27.50	27.50	27.50	28.75
..#17 Segment Basin.....	30.40	28.20	28.20	28.30	30.00
..Christian County.....	48.00	27.30	27.00	29.00	39.30
..Todd County.....	29.70	28.24	28.24	28.24	30.00
..#18 Segment Basin.....	32.00	30.00	30.00	30.00	31.06
..Christian County.....	45.00	25.62	25.62	27.50	36.88
..Todd County.....	31.11	29.64	29.64	29.64	30.86
..#19 Segment Basin.....	29.40	28.40	28.89	29.24	31.95
..Todd County.....	30.21	28.76	28.76	28.76	30.04
..Logan County.....	26.54	27.12	29.30	30.92	38.50

(con't) Exhibit A-2.5t-Basin and Sub-Basin Past and Projected Population Density (1960-1995)

Basin Breakdown	Trends, Persons/Sq. Mile		Projections, Persons/Sq. Mile		
	1960	1970	1975	1980	1995
..#20 Segment Basin.....	28.49	29.28	31.42	32.92	40.21
..Todd County.....	30.15	28.72	28.72	28.72	29.97
..Simpson County.....	26.04	27.16	31.03	32.65	40.30
..Logan County.....	29.03	30.11	32.06	33.80	42.08
..#21 Segment Basin.....	28.00	28.00	30.30	32.00	39.60
..Logan County.....	28.00	28.00	30.30	32.00	39.60
..#22 Segment Basin.....	26.25	27.50	31.25	33.75	41.25
..Simpson County.....	26.25	27.50	31.25	33.75	41.25

Appendix A-3: LOWER CUMBERLAND RIVER BASIN DISAGGREGATION OF

HOUSING TRENDS & PROJECTIONS

INTRODUCTION

Housing unit projections provide assistance in estimating increased wastewater volumes from residential areas. The projections contained in this appendix are based on 1970 U.S. Census data, and "persons per dwelling unit" projections made by the Urban Studies Center, University of Louisville, in its 1974 "Kentucky Housing Needs Analysis" (See Exh. A-3t). Housing unit projections also were made in the U. of L. study, but they could not be used because their population projections varied considerably from the EPA and KPDO figures which all basin consultants were required to follow.

The largest concentration of housing units, as shown by Exhibit A-3.1m, is projected for Christian County, primarily in and around the city of Hopkinsville. When the county totals are disaggregated to the L.C.R.B. segment basins, as shown by Exh. A-3.2t, the basins with the highest projected growth are #13 and #14 which represent the Hopkinsville area.

On the following pages, county projections and breakdowns are provided by Exhibit A-3.3t. These projections are then aggregated to segment basins (SB) by Exhibit A-3.4t.

Exh. A-3t: Persons Per Housing Unit, by LCRB County

County	1970	1975	1980	1995*
Livingston	2.875	2.7715	2.6568	2.6568
Crittenden	2.8110	2.9688	2.5749	2.5749
Lyon	3.3820	3.1765	2.9549	2.9549
Caldwell	2.8950	2.7970	2.6880	2.6880
Trigg	3.1810	3.0972	3.0033	3.0033
Christian	3.7840	3.6930	3.5907	3.5907
Todd	3.0990	3.0972	3.0033	3.0033
Logan	3.0920	3.0166	2.9319	2.9319
Simpson	3.1170	3.0672	3.0107	3.0107
Total	3.2916	3.2113	3.1126	3.1331

*Assumed to be identical to 1980 figures

Exh. A-3.2t: Housing Units by LCRB Segment Basins

SB	1970-75	1975-80	1980-95	SB	1970-75	1975-80	1980-95
#1	57	66	144	#13	875	701	2,629
#2	20	23	48	#14	587	489	1,833
#3	75	98	205	#15	3	15	58
#4	40	51	93	#16	4	27	99
#5	88	83	197	#17	1	23	38
#6	10	14	23	#18	1	15	25
#7	6	9	16	#19	23	44	96
#8	311	367	821	#20	291	252	796
#9	39	64	231	#21	3	3	8
#10	52	138	456	#22	1	1	2
#11	17	77	279	Total			
#12	6	40	150		2,510	2,600	8,247

Exh. A-3.1m: Housing Projections for the Lower Cumberland River Basin Counties

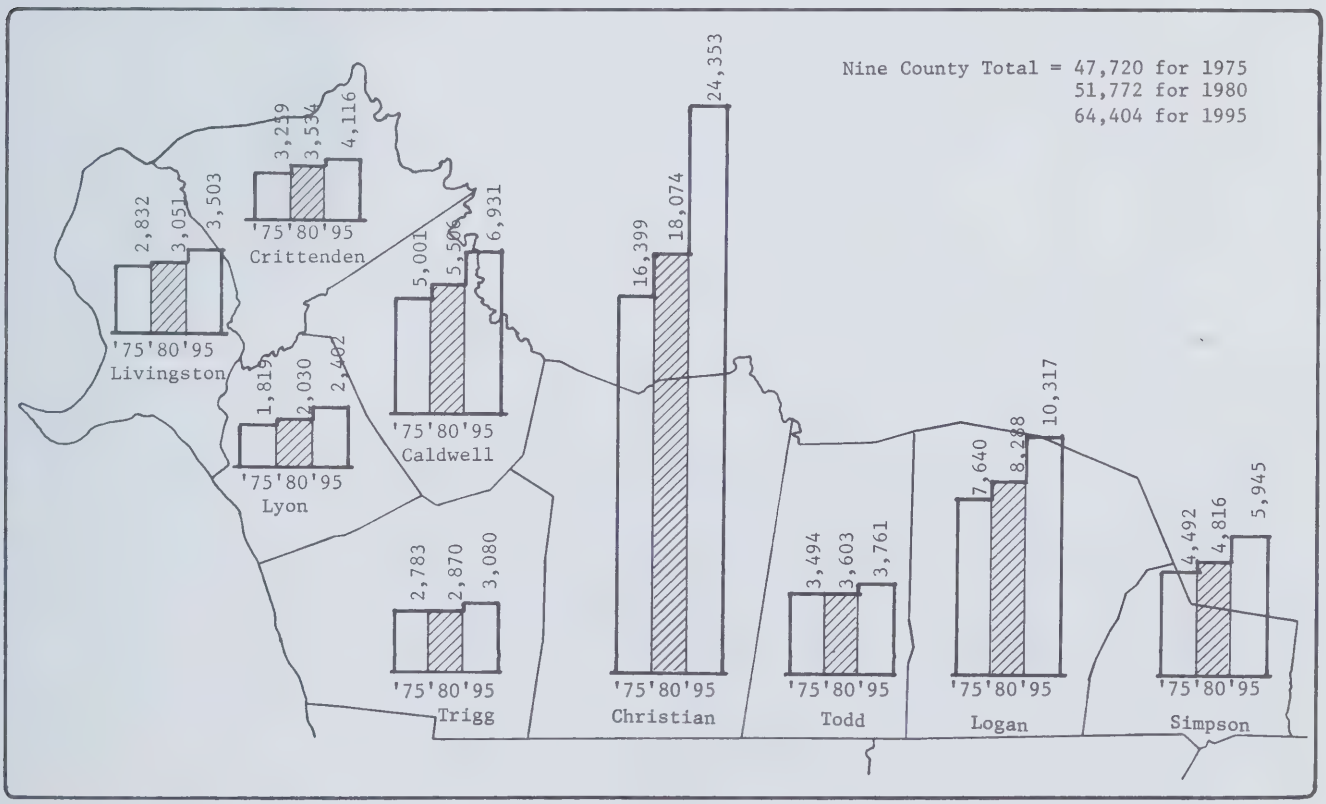


Exhibit A-3.3t: County Housing Units Trends and Projections, "At-Year" and "Between-Year" Change

County Breakdown	Housing Units "At-Year"				Housing Unit Number and Percentage Changes "Between-Year"					
					1970-75		1975-80		1980-1995	
	1970*1	1975*2	1980*2	1995*3	No.	(%)	No.	(%)	No.	(%)
NINE-COUNTY TOTAL.....	44,156	47,720	51,772	64,404	3,564	8.1	4,052	8.5	12,632	24.4
..Urban.....	16,647	18,525	20,427	26,540	1,878	11.3	1,902	10.3	6,113	30.0
..Rural.....	27,509	29,195	31,345	37,864	1,686	6.1	2,150	7.4	6,519	21.0
..Farm.....	11,183	11,981	12,867	15,497	798	7.1	886	7.4	2,630	20.4
..Non-Farm.....	16,326	17,214	18,478	22,367	888	5.4	1,264	7.3	3,889	21.0
..Outside LCRB.....	17,289	18,343	19,798	24,183	1,054	6.1	1,455	8.0	4,385	22.1
..Urban.....	5,268	5,446	5,930	7,253	178	3.4	484	9.0	1,322	22.3
..Rural.....	12,021	12,898	13,868	16,930	877	7.3	970	8.0	3,062	22.1
..Farm.....	5,407	5,856	6,302	7,647	449	8.3	446	8.0	1,345	21.3
..Non-Farm.....	6,614	7,042	7,566	9,283	428	6.5	524	7.4	1,717	22.7
..Inside LCRB.....	26,867	29,377	31,974	40,221	2,510	9.3	2,597	8.8	8,247	25.8
..Urban.....	11,379	13,079	14,497	19,287	1,700	14.9	1,418	10.8	4,790	33.0
..Rural.....	15,488	16,297	17,477	20,934	809	5.2	1,180	7.2	3,457	20.0
..Farm.....	5,776	6,125	6,565	7,850	349	6.0	440	7.2	1,285	20.0
..Non-Farm.....	9,712	10,172	10,912	13,084	460	4.7	740	7.3	2,172	20.0
LIVINGSTON CO. TOTAL.....	2,642*	2,832*	3,051	3,503	190	7.2	219	7.7	452	14.8
..Urban.....	0	0	0	0	0	0	0	0	0	0
..Rural.....	2,642	2,832	3,051	3,503	190	7.2	219	7.7	452	14.8
..Farm.....	2,034	2,180	2,349	2,697	146	7.2	169	7.8	348	14.8
..Non-Farm.....	608	652	702	806	44	7.2	50	7.7	104	14.8
..Outside LCRB.....	1,612	1,728	1,861	2,137	116	7.2	133	7.7	276	14.8
..North of LCRB.....	1,136	1,218	1,312	1,506	82	7.2	94	7.7	194	14.8
..Urban.....	0	0	0	0	0	0	0	0	0	0
..Rural.....	1,136	1,218	1,312	1,506	82	7.2	94	7.7	194	14.8
..Farm.....	875	938	1,010	1,160	63	7.2	72	7.7	150	14.9
..Non-Farm.....	261	280	302	346	19	7.3	22	7.5	44	14.6
..South of LCRB.....	476	510	549	630	34	7.1	39	7.6	81	14.8
..Urban.....	0	0	0	0	0	0	0	0	0	0
..Rural.....	476	510	549	630	34	7.1	39	7.6	81	14.8
..Farm.....	366	393	423	486	27	7.4	30	7.6	63	14.9
..Non-Farm.....	110	117	126	144	7	6.3	9	7.7	18	14.3
..Inside LCRB.....	1,030	1,105	1,190	1,366	75	7.3	85	7.7	176	14.8
..Urban.....	0	0	0	0	0	0	0	0	0	0
..Rural.....	1,030	1,105	1,190	1,366	75	7.3	85	7.7	176	14.8
..Farm.....	793	851	916	1,051	58	7.3	65	7.5	135	14.8
..Non-Farm.....	237	254	274	315	17	7.2	20	7.9	41	14.9
..#1 Segment Basin.....	581	623	671	770	42	7.2	48	7.7	99	14.8
..Urban.....	0	0	0	0	0	-	0	-	-	-
..Rural.....	581	623	671	770	42	-	48	-	99	-
..Farm.....	448	480	517	594	32	-	37	-	77	-
..Non-Farm.....	134	143	154	176	9	-	11	-	22	-

*1-These figures are taken from the 1970 census report on "Detailed Housing Characteristics in Kentucky", Vol. HC(1)-B19 Ky. Tables 54, 58, and 60. All figures pertain to persons living in housing units only, and do not include persons living in group quarters. Thus, in Christian County for instance, the 1970 population was 56,224, but only 47,277 were living in housing units included in this table, while the remaining 8,947 persons were living in group quarters.

*2-1975 and 1980 housing figures were obtained by dividing that year's population by the population per unit, as shown on Table 16-4, Appendix V-A, of the "Kentucky Housing Needs Projection", University of Louisville, Urban Studies Center, 1974.

*3-1980 persons per housing unit was divided into 1995 population to secure 1995 housing units. The U of L study projected only to 1980.

(con't) Exhibit A-3.3t: County Housing Units Trends and Projections, "At-Year" and "Between-Year" Change

County Breakdown	Housing Units "At-Year"				Housing Unit Number and Percentage Changes "Between-Year"					
					1970-1975		1975-1980		1980-1995	
	1970	1975	1980	1995	No.	(%)	No.	(%)	No.	(%)
..#2 Segment Basin.....	264	283	305	350	19	7.2	22	7.8	45	14.8
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	264	283	305	350	19	-	22	-	45	-
..Farm.....	203	211	235	270	8	-	24	-	35	-
..Non-Farm.....	61	72	70	80	11	-	-2	-	10	-
..#4 Segment Basin.....	174	187	201	231	13	7.5	14	7.5	30	14.9
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	174	187	201	231	13	-	14	-	30	-
..Farm.....	134	144	155	178	10	-	11	-	23	-
..Non-Farm.....	40	43	46	53	3	-	3	-	7	-
..#5 Segment Basin.....	10	11	12	14	1	10.0	1	9.9	2	16.7
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	10	11	12	14	1	-	1	-	2	-
..Farm.....	8	9	9	11	1	-	0	-	2	-
..Non-Farm.....	2	2	3	3	0	-	1	-	0	-
CRITTENDEN COUNTY.....	3,021	3,259	3,534	4,116	238	7.9	275	8.4	582	16.5
..Urban - Marion.....	1,070	1,186	1,322	1,540	116	10.8	136	11.5	218	16.5
..Rural.....	1,951	2,073	2,212	2,576	122	6.2	139	6.7	364	16.4
..Farm.....	586	622	664	773	36	6.1	42	6.8	109	16.4
..Non-Farm.....	1,365	1,451	1,549	1,804	86	6.3	97	6.7	255	16.5
..Outside LCRB.....	2,572	2,782	3,025	3,523	210	8.2	243	8.7	498	16.5
..Urban.....	1,070	1,186	1,322	1,540	116	10.8	136	11.5	218	16.5
..Rural.....	1,502	1,596	1,704	1,985	94	6.2	108	6.8	281	16.5
..Farm.....	451	479	511	595	28	6.2	32	6.7	84	16.4
..Non-Farm.....	1,051	1,118	1,193	1,390	66	6.3	75	6.7	197	16.5
..Inside LCRB.....	449	477	509	593	28	6.2	32	6.7	84	16.5
..Urban.....	0	0	0	0	0	0	0	0	0	0
..Rural.....	449	477	509	593	28	6.2	32	6.7	84	16.5
..Farm.....	135	143	153	178	8	6.0	10	7.0	25	16.3
..Non-Farm.....	314	334	356	415	20	6.4	22	6.6	59	16.6
..#1 Segment Basin.....	242	257	275	320	15	6.2	18	7.0	45	16.4
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	242	257	275	320	15	-	18	-	45	-
..Farm.....	73	77	83	97	4	-	6	-	14	-
..Non-Farm.....	169	180	192	223	11	-	12	-	31	-
..#2 Segment Basin.....	18	19	20	23	-1	5.5	1	5.3	3	15.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	18	19	20	23	-1	-	1	-	3	-
..Farm.....	5	6	6	7	1	-	0	-	1	-
..Non-Farm.....	13	13	14	16	0	-	1	-	2	-
..#3 Segment Basin.....	188	200	214	249	12	6.4	14	7.0	35	16.4
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	188	200	214	249	12	-	14	-	35	-
..Farm.....	57	60	64	74	3	-	4	-	10	-
..Non-Farm.....	131	140	150	175	9	-	10	-	25	-
LYON CO. TOTAL.....	1,645	1,819	2,030	2,402	174	10.6	211	11.6	372	18.3
..Urban.....	0	0	0	0	0	0	0	0	0	0
..Rural.....	1,645	1,819	2,030	2,402	174	10.6	211	11.6	372	18.3
..Farm.....	428	473	528	625	45	10.5	55	11.6	97	18.3
..Non-Farm.....	1,217	1,346	1,502	1,777	129	10.7	156	11.5	275	18.3

(con't) Exhibit A-3.3t: County Housing Units Trends and Projections, "At-Year" and "Between-Year" Change

County Breakdown	Housing Units "At-Year"				Housing Unit Number and Percentage Changes "Between-Year"					
					1970-1975		1975-1980		1980-1995	
	1970	1975	1980	1995	No.	(%)	No.	(%)	No.	(%)
..Outside LCRB.....	0	0	0	0	0	0	0	0	0	0
..Urban.....	0	0	0	0	0	0	0	0	0	0
..Rural.....	0	0	0	0	0	0	0	0	0	0
..Farm.....	0	0	0	0	0	0	0	0	0	0
..Non-Farm.....	0	0	0	0	0	0	0	0	0	0
..Inside LCRB.....	1,645	1,819	2,030	2,402	174	10.6	211	11.6	372	18.3
..Urban.....	0	0	0	0	0	0	0	0	0	0
..Rural.....	1,645	1,819	2,030	2,402	174	10.6	211	11.6	372	18.3
..Farm.....	428	473	528	625	45	10.5	55	11.6	97	18.3
..Non-Farm.....	1,217	1,346	1,502	1,777	129	10.7	156	11.5	275	18.3
..#3 Segment Basin.....	556	609	683	810	53	9.5	74	12.1	127	18.6
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	556	609	683	810	53	9.5	74	-	127	-
..Farm.....	129	140	158	189	11	-	18	-	31	-
..Non-Farm.....	427	469	525	621	42	-	56	-	96	-
..#4 Segment Basin.....	278	305	342	405	27	9.7	37	12.1	63	18.4
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	278	305	342	405	27	-	37	-	63	-
..Farm.....	64	70	79	93	6	-	9	-	14	-
..Non-Farm.....	214	235	263	312	21	-	28	-	49	-
..#5 Segment Basin.....	463	525	579	685	62	13.4	54	10.3	106	18.3
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	463	525	579	685	62	-	54	-	106	-
..Farm.....	154	175	193	228	24	-	18	-	35	-
..Non-Farm.....	309	350	386	457	41	-	36	-	71	-
..#6 Segment Basin.....	104	114	128	151	10	9.6	14	12.3	23	18.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	104	114	128	151	10	-	14	-	23	-
..Farm.....	24	26	29	34	2	-	3	-	5	-
..Non-Farm.....	80	88	99	117	8	-	11	-	18	-
..#7 Segment Basin.....	70	76	85	101	6	8.6	9	11.8	16	18.8
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	70	76	85	101	6	-	9	-	16	-
..Farm.....	16	18	20	24	2	-	2	-	4	-
..Non-Farm.....	54	58	65	77	4	-	7	-	12	-
..#8 Segment Basin.....	174	190	214	253	16	9.2	24	12.6	39	18.2
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	174	190	214	253	16	-	24	-	39	-
..Farm.....	40	43	50	59	3	-	7	-	9	-
..Non-Farm.....	134	147	164	194	13	-	17	-	30	-
CALDWELL COUNTY.....	4,552	5,001	5,506	6,931	449	9.9	505	10.1	1,425	25.9
..Urban - Princeton	2,173	2,471	2,819	3,549	298	13.7	348	14.0	730	25.9
..Rural.....	2,379	2,531	2,687	3,382	151	6.3	156	6.2	695	25.9
..Farm.....	785	835	887	1,117	50	6.4	52	6.2	230	25.9
..Non-Farm.....	1,594	1,695	1,800	2,265	101	6.3	105	6.1	465	25.8
..Outside LCRB.....	1,550	1,664	1,786	2,248	114	7.4	122	7.3	462	25.8
..Urban - Princeton.....	217	247	282	355	30	13.8	35	14.2	73	25.8
..Rural.....	1,332	1,417	1,504	1,893	84	6.3	87	6.1	389	25.8
..Farm.....	440	468	496	624	28	6.4	28	6.0	128	25.8
..Non-Farm.....	892	950	1,008	1,269	58	6.5	58	6.1	261	25.8

(con't) Exhibit A-3.3t: County Housing Units Trends and Projections, "At-Year" and "Between-Year" Change

County Breakdown	Housing Units "At-Year"				Housing Unit Number and Percentage Changes "Between-Year"					
					1970-1975		1975-1980		1980-1995	
	1970	1975	1980	1995	No.	(%)	No.	(%)	No.	(%)
..Inside LCRB.....	3,003	3,337	3,719	4,681	334	11.1	382	11.4	962	25.8
..Urban - Princeton.....	1,956	2,223	2,537	3,194	267	13.6	314	14.1	657	25.8
..Rural.....	1,047	1,113	1,182	1,487	67	6.4	69	6.2	305	25.8
..Farm.....	345	368	390	491	23	6.7	22	6.0	101	25.8
..Non-Farm.....	702	746	792	996	44	6.3	46	6.2	204	25.8
..#3 Segment Basin.....	146	156	166	209	10	6.8	10	6.4	43	25.9
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	146	156	166	209	10	-	10	-	43	-
..Farm.....	48	52	55	69	4	-	3	-	14	-
..Non-Farm.....	98	104	111	140	6	-	7	-	29	-
..#5 Segment Basin.....	157	167	177	223	10	6.4	10	6.0	46	25.9
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	157	167	177	223	10	-	10	-	46	-
..Farm.....	52	55	58	73	3	-	3	-	15	-
..Non-Farm.....	105	112	119	150	7	-	7	-	31	-
..#8 Segment Basin.....	2,375	2,669	3,010	3,789	294	12.4	341	12.8	779	26.0
..Urban.....	1,956	2,224	2,537	3.194	268	-	313	-	657	-
..Rural.....	419	445	473	595	26	-	28	-	122	-
..Farm.....	138	147	156	196	9	-	9	-	40	-
..Non-Farm.....	281	298	317	399	17	-	19	-	82	-
..#9 Segment Basin.....	324	345	366	461	21	6.5	21	6.1	95	26.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	324	345	366	461	21	-	21	-	95	-
..Farm.....	107	114	121	152	7	-	7	-	31	-
..Non-Farm.....	217	231	245	308	14	-	14	-	64	-
TRIGG CO. TOTAL.....	2,710	2,783	2,870	3,080	73	2.7	87	3.1	210	7.3
..Urban.....	0	0	0	0	0	0	0	0	0	0
..Rural.....	2,710	2,783	870	3,080	73	2.7	87	3.1	210	7.3
..Farm.....	867	890	918	985	23	2.6	28	3.1	67	7.3
..Non-Farm.....	1,843	1,892	1,952	2,095	49	2.6	60	3.2	143	7.3
..Outside LCRB.....	0	0	0	0	0	0	0	0	0	0
..Urban.....	0	0	0	0	0	0	0	0	0	0
..Rural.....	0	0	0	0	0	0	0	0	0	0
..Farm.....	0	0	0	0	0	0	0	0	0	0
..Non-Farm.....	0	0	0	0	0	0	0	0	0	0
..Inside LCRB.....	2,710	2,783	2,870	3,080	73	2.7	87	3.1	210	7.3
..Urban.....	0	0	0	0	0	0	0	0	0	0
..Rural.....	2,710	2,783	2,870	3,080	73	2.7	87	3.1	210	7.3
..Farm.....	867	890	918	985	23	2.6	28	3.1	67	7.3
..Non-Farm.....	1,843	1,892	1,952	2,095	49	2.6	60	3.2	143	7.3
..#5 Segment Basin.....	558	573	91	634	15	2.7	18	3.1	43	7.3
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	558	573	591	634	15	-	18	-	43	-
..Farm.....	179	184	189	203	5	-	5	-	14	-
..Non-Farm.....	379	389	402	431	10	-	13	-	29	-
..#8 Segment Basin.....	38	39	41	44	1	2.6	2	5.1	3	7.3
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	38	39	41	44	1	-	2	-	3	-
..Farm.....	12	13	13	14	1	-	0	-	1	-
..Non-Farm.....	26	26	28	30	0	-	2	-	2	-

(con't) Exhibit A-3.3t: County Housing Units Trends and Projections, "At-Year" and "Between-Year" Change

County Breakdown	Housing Units "At-Year"				Housing Unit Number and Percentage Changes "Between-Year"					
					1970-1975		1975-1980		1980-1995	
	1970	1975	1980	1995	No.	(%)	No.	(%)	No.	(%)
..#9 Segment Basin.....	538	552	570	612	14	2.6	18	3.3	42	7.4
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	538	552	570	612	14	-	18	-	42	-
..Farm.....	172	176	182	196	4	-	6	-	14	-
..Non-Farm.....	366	376	388	416	10	-	12	-	28	-
..#10 Segment Basin.....	1,383	1,420	465	1,572	37	2.7	45	3.2	107	7.3
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	1,383	1,420	1,465	1,572	37	-	45	-	107	-
..Farm.....	443	455	469	503	12	-	14	-	34	-
..Non-Farm.....	940	966	996	1,069	26	-	30	-	73	-
..#11 Segment Basin.....	192	198	204	219	6	3.1	6	3.0	15	7.4
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	192	198	204	219	6	-	6	-	15	-
..Farm.....	62	63	65	70	1	-	2	-	5	-
..Non-Farm.....	130	135	139	149	5	-	4	-	10	-
CHRISTIAN CO. TOTAL.....	14,858	16,399	18,074	24,353	1,541	10.4	1,675	10.2	6,279	35.0
..Urban.....	9,214	10,659	11,748	15,829	1,445	16.0	1,089	10.2	4,081	35.0
..Rural.....	5,644	5,740	6,326	8,524	96	2.0	586	10.2	2,198	35.0
..Farm.....	1,693	1,722	1,898	2,557	29	2.0	176	10.2	659	35.0
..Non-Farm.....	3,951	4,018	4,428	5,966	67	2.0	410	10.2	1,539	35.0
..Outside LCRB.....	2,032	2,066	2,277	3,068	34	2.0	211	10.2	791	35.0
..Urban.....	0	0	0	0	0	0	0	0	0	0
..Rural.....	2,032	2,066	2,277	3,068	34	2.0	211	10.2	791	35.0
..Farm.....	610	620	683	920	10	2.0	63	10.2	237	35.0
..Non-Farm.....	1,422	1,446	1,594	2,148	24	2.0	148	10.2	554	35.0
..Inside LCRB.....	12,826	14,333	15,797	21,285	1,507	12.0	1,464	10.0	5,488	35.0
..Urban.....	9,214	10,660	11,748	15,829	1,446	16.0	1,088	10.0	4,081	35.0
..Rural.....	3,612	3,673	4,049	5,456	61	2.0	376	10.0	1,407	35.0
..Farm.....	1,084	1,102	1,214	1,636	18	2.0	112	10.0	422	35.0
..Non-Farm.....	2,528	2,571	2,835	3,820	43	2.0	264	10.0	985	35.0
..#9 Segment Basin.....	242	246	271	365	4	2.0	25	10.0	94	35.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	242	246	271	365	4	-	25	-	94	-
..Farm.....	73	74	81	109	1	-	7	-	28	-
..Non-Farm.....	169	172	190	256	3	-	18	-	66	-
..#10 Segment Basin.....	896	911	1,004	1,353	15	2.0	93	10.0	349	35.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	896	911	1,004	1,353	15	-	93	-	349	-
..Farm.....	269	273	301	406	4	-	28	-	105	-
..Non-Farm.....	627	638	703	947	11	-	65	-	244	-
..#11 Segment Basin.....	679	690	761	1,025	11	2.0	71	10.0	264	35.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	679	690	761	1,025	11	-	71	-	264	-
..Farm.....	204	207	228	307	3	-	21	-	79	-
..Non-Farm.....	475	483	533	718	8	-	50	-	185	-
..#12 Segment.....	387	393	433	583	6	2.0	40	10.0	150	35.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	387	393	433	583	6	-	40	-	150	-
..Farm.....	116	118	130	175	2	-	12	-	45	-
..Non-Farm.....	271	275	303	408	4	-	28	-	105	-

(con't) Exhibit A-3.3t: County Housing Units Trends and Projections, "At-Year" and "Between-Year" Change

County Breakdown	Housing Units "At-Year"				Housing Unit Number and Percentage Changes "Between-Year"					
					1970-1975		1975-1980		1980-1995	
	1970	1975	1980	1995	No.	(%)	No.	(%)	No.	(%)
..#13 Segment Basin.....	5,991	6,866	7,567	10,196	875	15.0	701	10.0	2,629	35.0
..Urban.....	5,528	6,396	7,050	9,500	868	-	654	-	2,450	-
..Rural.....	463	470	517	696	7	-	47	-	179	-
..Farm.....	139	141	155	209	2	-	14	-	54	-
..Non-Farm.....	324	329	362	487	5	-	33	-	125	-
..#14 Segment Basin.....	4,198	4,785	5,274	7,106	587	14.0	489	10.0	1,832	35.0
..Urban.....	3,686	4,264	4,700	6,333	577	-	436	-	1,633	-
..Rural.....	512	522	574	773	10	-	52	-	199	-
..Farm.....	153	156	172	232	3	-	16	-	60	-
..Non-Farm.....	359	366	402	541	7	-	36	-	139	-
..#15 Segment Basin.....	148	151	166	224	3	2.0	15	10.0	58	35.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	148	151	166	224	3	-	15	0	58	-
..Farm.....	44	45	50	68	1	-	5	-	18	-
..Non-Farm.....	104	106	116	156	2	-	10	-	40	-
..#16 Segment Basin.....	253	257	284	383	4	2.0	27	11.0	99	35.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	253	257	284	383	4	-	27	-	99	-
..Farm.....	76	77	85		1	-	8	-	30	-
..Non-Farm.....	177	180	199	268	3	-	19	-	69	-
..#17 Segment Basin.....	22	22	24	32	0	0	2	9.0	8	33.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	22	22	24	32	0	-	2	-	8	-
..Farm.....	7	7	7	9	0	-	0	-	2	-
..Non-Farm.....	15	15	17	23	0	-	2	-	6	-
..#18 Segment Basin.....	11	11	12	16	0	0	1	9.0	4	33.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	11	11	12	16	0	-	1	-	4	-
..Farm.....	3	3	4	5	0	-	1	-	1	-
..Non-Farm.....	8	8	8	11	0	-	0	-	3	-
TODD CO. TOTAL.....	3,492	3,494	3,603	3,761	2	.06	109	3.1	158	4.4
..Urban.....	0	0	0	0	0	0	0	0	0	0
..Rural.....	3,492	3,494	3,603	3,761	2	.06	109	3.1	158	4.4
..Farm.....	1,152	1,153	1,189	1,241	1	.08	36	3.1	52	4.4
..Non-Farm.....	2,340	2,341	2,414	2,520	1	.04	73	3.1	106	4.4
..Outside LCRB.....	1,222	1,223	1,261	1,316	1	.08	38	3.1	55	4.4
..Urban.....	0	0	0	0	0	0	0	0	0	0
..Rural.....	1,222	1,223	1,261	1,316	1	.08	38	3.1	55	4.4
..Farm.....	403	404	416	434	1	.2	12	3.0	18	4.3
..Non-Farm.....	819	819	845	882	0	0	26	3.2	37	4.4
..Inside LCRB.....	2,270	2,271	2,342	2,445	1	.04	71	3.1	103	4.4
..Urban.....	0	0	0	0	0	0	0	0	0	0
..Rural.....	2,270	2,271	2,342	2,445	1	.04	71	3.1	103	4.4
..Farm.....	749	750	773	807	1	.1	23	3.1	34	4.4
..Non-Farm.....	1,521	1,521	1,569	1,638	0	0	48	3.2	69	4.4
..#14 Segment Basin.....	14	14	14	15	0	0	0	0	1	7.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	14	14	14	15	0	-	0	-	1	-
..Farm.....	4	4	4	4	0	-	0	-	0	-
..Non-Farm.....	10	10	10	11	0	-	0	-	1	-

(con't) Exhibit A-3.3t: County Housing Units Trends and Projections, "At-Year" and "Between-Year" Change

County Breakdown	Housing Units "At-Year"				Housing Unit Number and Percentage Changes "Between-Year"					
					1970-1975		1975-1980		1980-1995	
	1970	1975	1980	1995	No.	(%)	No.	(%)	No.	(%)
..#15 Segment Basin.....	7	7	7	7	0	0	0	0	0	0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	7	7	7	7	0	-	0	-	0	-
..Farm.....	2	2	2	2	0	-	0	-	0	-
..Non-Farm.....	5	5	5	5	0	-	0	-	0	-
..#16 Segment Basin.....	7	7	7	7	0	0	0	0	0	0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	7	7	7	7	0	-	0	-	0	-
..Farm.....	2	2	2	2	0	-	0	-	0	-
..Non-Farm.....	5	5	5	5	0	-	0	-	0	-
..#17 Segment Basin.....	663	664	685	715	1	.15	21	3.2	30	4.4
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	663	664	685	715	1	-	21	-	30	-
..Farm.....	223	224	231	241	1	-	7	-	10	-
..Non-Farm.....	440	440	454	474	0	-	14	-	20	-
..#18 Segment Basin.....	454	455	469	490	1	.2	14	3.1	21	4.5
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	454	455	469	490	1	-	14	-	21	-
..Farm.....	146	146	150	157	0	-	4	-	7	-
..Non-Farm.....	308	309	319	333	1	-	10	-	14	-
..#19 Segment Basin.....	761	761	785	819	0	0	24	3.2	34	4.3
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	761	761	785	819	0	-	24	-	34	-
..Farm.....	251	251	259	270	0	-	8	-	11	-
..Non-Farm.....	510	510	526	549	0	-	16	-	23	-
..#20 Segment Basin.....	363	363	374	390	0	0	11	3.0	16	4.3
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	363	363	374	390	0	-	11	-	16	-
..Farm.....	120	120	124	129	0	-	4	-	5	-
..Non-Farm.....	243	243	250	261	0	-	7	-	11	-
LOGAN CO. TOTAL.....	7,048	7,640	8,288	10,317	592	8.4	648	8.5	2,029	24.5
..Urban - Russellville....	2,088	2,143	2,323	2,892	55	3.0	180	8.4	569	24.5
..Rural.....	4,960	5,497	5,965	7,425	537	11.0	468	8.5	1,460	24.5
..Farm.....	2,282	2,529	2,744	3,416	247	11.0	215	8.5	672	24.5
..Non-Farm.....	2,678	2,968	3,221	4,009	290	11.0	253	8.5	788	25.5
..Outside.....	4,756	5,134	5,570	6,934	378	8.0	436	8.0	1,364	24.5
..Urban.....	1,879	1,946	2,111	2,628	67	4.0	165	8.0	517	24.5
..Rural.....	2,877	3,188	3,459	4,306	311	11.0	271	9.0	847	24.5
..Farm.....	1,323	1,467	1,591	1,981	144	11.0	124	8.0	390	24.5
..Non-Farm.....	1,554	1,721	1,868	2,325	167	11.0	147	9.0	457	24.5
..Inside LCRB.....	2,292	2,506	2,718	3,383	214	9.0	212	8.0	665	24.5
..Urban.....	209	196	212	264	-13	-6.0	16	8.0	52	24.5
..Rural.....	2,083	2,310	2,506	3,119	227	11.0	196	8.0	613	24.5
..Farm.....	958	1,063	1,153	1,435	105	11.0	90	8.0	282	24.5
..Non-Farm.....	1,125	1,247	1,353	1,684	122	11.0	106	9.0	331	24.5
..#19 Segment Basin.....	210	233	253	315	23	11.0	20	9.0	62	24.5
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	210	233	253	315	23	-	20	-	62	-
..Farm.....	97	107	116	144	10	-	9	-	28	-
..Non-Farm.....	113	126	137	171	13	-	11	-	34	-

(con't) Exhibit A-3.3t: County Housing Units Trends and Projections, "At-Year" and "Between-Year" Change

County Breakdown	Housing Units "At-Year"				Housing Unit Number and Percentage Changes "Between Year"					
					1970-1975		1975-1980		1980-1995	
	1970	1975	1980	1995	No.	(%)	No.	(%)	No.	(%)
..#20 Segment Basin.....	2,055	2,243	2,432	3,027	188	9.0	189	8.0	595	24.5
..Urban.....	209	196	212	264	-13	-	16	-	52	-
..Rural.....	1,846	2,047	2,220	2,763	201	-	173	-	543	-
..Farm.....	849	941	1,022	1,272	92	-	1	-	250	-
..Non-Farm.....	997	1,106	1,198	1,491	109	-	92	-	293	-
..#21 Segment Basin.....	27	30	33	41	3	11.0	3	10.0	8	24.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	27	30	33	41	3	-	3	-	8	-
..Farm.....	13	14	15	19	1	-	1	-	4	-
..Non-Farm.....	14	16	18	22	2	-	2	-	4	-
SIMPSON CO. TOTAL.....	4,188	4,492	4,816	5,945	304	7.0	324	7.0	1,129	23.44
..Urban.....	2,102	2,066	2,215	2,734	-36	2.0	149	7.0	519	23.43
..Rural.....	2,086	2,426	2,601	3,211	340	16.0	175	7.0	610	23.45
..Farm.....	1,356	1,577	1,690	2,086	221	16.0	113	6.0	396	23.43
..Non-Farm.....	730	849	910	1,123	119	16.0	61	7.0	213	23.4
..Outside LCRB.....	3,546	3,746	4,016	4,958	200	6.0	270	7.0	942	23.5
..Urban.....	2,102	2,066	2,215	2,734	-36	2.0	149	7.0	519	23.43
..Rural.....	1,444	1,680	1,801	2,224	236	16.0	121	7.0	423	23.5
..Farm.....	938	1,092	1,171	1,446	154	16.0	79	7.0	275	23.5
..Non-Farm.....	506	588	630	778	82	16.0	42	7.0	148	23.5
..Inside LCRB.....	642	746	799	986	104	16.0	53	7.0	187	23.0
..Urban.....	0	0	0	0	0	0	0	0	0	0
..Rural.....	642	746	799	986	104	16.0	53	7.0	187	23.0
..Farm.....	417	485	520	642	68	16.0	35	7.0	122	24.0
..Non-Farm.....	225	261	279	344	36	16.0	18	7.0	65	23.0
..#20 Segment Basin.....	635	738	790	975	103	16.0	52	7.0	185	23.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	635	738	790	975	103	-	52	-	185	-
..Farm.....	413	479	514	634	66	-	35	-	120	-
..Non-Farm.....	222	259	276	341	37	-	17	-	65	-
..#22 Segment Basin.....	7	8	9	11	1	14.0	1	13.0	2	22.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	7	8	9	11	1	-	1	-	2	-
..Farm.....	5	5	6	7	0	-	1	-	1	-
..Non-Farm.....	2	3	3	4	1	-	0	-	1	-

Exhibit A-3.4t: Segment Basin-Housing Units* Trends and Projections, "At-Year" and "Between-Year" Changes

Segment Breakdown	Housing Units "At-Year"				Housing Unit Number and Percentage Change "Between-Year"					
					1970-1975		1975-1980		1980-1995	
	1970	1975	1980	1995	No.	(%)	No.	(%)	No.	(%)
NINE-COUNTY TOTAL.....	44,156	47,720	51,772	64,404	3,564	8.1	4,052	8.5	12,632	24.4
..Urban.....	16,647	18,525	20,427	26,540	1,878	11.3	1,902	10.3	6,113	30.0
..Rural.....	27,509	29,195	31,345	37,864	1,686	6.1	2,150	7.4	6,519	21.0
..Farm.....	11,183	11,981	12,867	15,497	798	7.1	886	7.4	2,630	20.4
..Non-Farm.....	16,326	17,214	18,478	22,367	888	5.4	1,264	7.3	3,889	21.0
..Outside LCRB.....	17,289	18,343	19,798	24,183	1,054	6.1	1,455	8.0	4,385	22.1
..Urban.....	5,268	5,446	5,930	7,253	178	3.4	484	9.0	1,322	22.3
..Rural.....	12,021	12,898	13,868	16,930	877	7.3	970	8.0	3,062	22.1
..Farm.....	5,407	5,856	6,302	7,647	449	8.3	446	8.0	1,345	21.3
..Non-Farm.....	6,614	7,042	7,566	9,283	428	6.5	524	7.4	1,717	22.7
..Inside LCRB.....	26,867	29,377	31,974	40,221	2,510	9.3	2,597	8.8	8,247	25.8
..Urban.....	11,379	13,079	14,497	19,287	1,700	14.9	1,418	10.8	4,790	33.0
..Rural.....	15,488	16,297	17,477	20,934	809	5.2	1,180	7.2	3,457	20.0
..Farm.....	5,776	6,125	6,565	7,850	349	6.0	440	7.2	1,285	20.0
..Non-Farm.....	9,712	10,172	10,912	13,084	460	4.7	740	7.3	2,172	20.0
..#1 Segment Basin.....	823	880	946	1,090	57	6.9	66	7.5	144	15.22
..Livingston County....	581	623	671	770	42	7.2	48	7.7	99	14.8
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	581	623	671	770	42	-	48	-	99	-
..Farm.....	448	480	517	594	32	-	37	-	77	-
..Non-Farm.....	134	143	154	176	9	-	11	-	22	-
..Crittenden County....	242	257	275	320	15	6.2	18	7.0	45	16.4
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	242	257	275	320	15	-	18	-	45	-
..Farm.....	73	77	83	97	4	-	6	-	14	-
..Non-Farm.....	169	180	192	223	11	-	12	-	31	-
..#2 Segment Basin.....	282	302	325	373	20	7.1	23	7.6	48	14.8
..Livingston County....	264	283	305	350	19	7.2	22	7.8	45	14.8
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	264	283	305	350	19	-	22	-	45	-
..Farm.....	203	211	235	270	8	-	24	-	35	-
..Non-Farm.....	61	72	70	80	11	-	-2	-	10	-
..Crittenden County....	18	19	20	23	1	5.5	1	5.3	3	15.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	18	19	20	23	1	-	1	-	3	-
..Farm.....	5	6	6	7	1	-	0	-	1	-
..Non-Farm.....	13	13	14	16	0	-	1	-	2	-
..#3 Segment Basin.....	890	965	1,063	1,268	75	8.4	98	10.2	205	19.3
..Caldwell Co.....	146	156	166	209	10	6.8	10	6.4	43	25.9
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	146	156	166	209	10	-	10	-	43	-
..Farm.....	48	52	55	69	4	-	3	-	14	-
..Non-Farm.....	98	104	111	140	6	-	7	-	29	-
..Crittenden County....	188	200	214	249	12	6.4	14	7.0	35	16.4
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	188	200	214	249	12	-	14	-	35	-
..Farm.....	57	60	64	74	3	-	4	-	10	-
..Non-Farm.....	131	140	150	175	9	-	10	-	25	-

*Occupied housing units (see Table 62, U.S. Census 1970 "Detailed Housing Characteristics for Kentucky".

(con't) Exhibit A-3.4t: Basin-Housing Units Trends and Projections, "At-Year" and "Between-Year" Changes

Segment Breakdown	Housing Units "At-Year"				Housing Unit Number and Percentage Changes "Between-Year"					
					1970-1975		1975-1980		1980-1995	
	1970	1975	1980	1995	No.	(%)	No.	(%)	No.	(%)
..Lyon County.....	556	609	683	810	53	9.5	74	12.1	127	18.6
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	556	609	683	810	53	-	74	-	127	-
..Farm.....	129	140	158	189	11	-	18	-	31	-
..Non-Farm.....	427	469	525	621	42	-	56	-	96	-
..#4 Segment Basin.....	452	492	543	636	40	8.8	51	10.4	93	17.1
..Livingston County..	174	187	201	231	13	7.5	14	7.5	30	14.9
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	174	187	201	231	13	-	14	-	30	-
..Farm.....	134	144	155	178	10	-	11	-	23	-
..Non-Farm.....	40	43	46	53	3	-	3	-	7	-
..Lyon County.....	278	305	342	405	27	9.7	37	12.1	63	18.4
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	278	305	342	405	27	-	37	-	63	-
..Farm.....	64	70	79	93	6	-	9	-	14	-
..Non-Farm.....	214	235	263	312	21	-	28	-	49	-
..#5 Segment Basin.....	1,188	1,276	1,359	1,556	88	7.4	83	6.5	197	14.5
..Livingston County..	10	11	12	14	1	10.0	1	9.9	2	16.7
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	10	11	12	14	1	-	1	-	2	-
..Farm.....	8	9	9	11	1	-	0	-	2	-
..Non-Farm.....	2	2	3	3	0	-	1	-	0	-
..Lyon County.....	463	525	579	685	62	13.4	54	10.3	106	18.3
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	463	525	579	685	62	-	54	-	106	-
..Farm.....	154	175	193	228	21	-	18	-	35	-
..Non-Farm.....	309	350	386	457	41	-	36	-	71	-
..Caldwell County....	157	167	177	223	10	6.4	10	6.0	46	25.9
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	157	167	177	223	10	-	10	-	46	-
..Farm.....	52	55	58	73	3	-	3	-	15	-
..Non-Farm.....	105	112	119	150	7	-	7	-	31	-
..Trigg County.....	558	573	591	634	15	2.7	18	3.1	43	7.3
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	558	573	591	634	15	-	18	-	43	-
..Farm.....	179	184	189	203	5	-	5	-	14	-
..Non-Farm.....	379	389	402	431	10	-	13	-	29	-
..#6 Segment Basin.....	104	114	128	151	10	9.6	14	12.3	23	18.0
..Lyon County.....	104	114	128	151	10	9.6	14	12.3	23	18.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	104	114	128	151	10	-	14	-	23	-
..Farm.....	24	26	29	34	2	-	3	-	5	-
..Non-Farm.....	80	88	99	117	8	-	11	-	18	-
..#7 Segment Basin.....	70	76	85	101	6	8.6	9	11.8	16	18.8
..Lyon County.....	70	76	85	101	6	8.6	9	11.8	16	18.8
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	70	76	85	101	6	-	9	-	16	-
..Farm.....	16	18	20	24	2	-	2	-	4	-
..Non-Farm.....	54	58	65	77	4	-	7	-	12	-

(con't) Exhibit A-3.4t: Basin-Housing Units Trends and Projections, "At-Year" and "Between-Year" Changes

Segment Breakdown	Housing Units "At-Year"				Housing Unit Number and Percentage Changes "Between-Year"					
					1970-1975		1975-1980		1980-1995	
	1970	1975	1980	1995	No.	(%)	No.	(%)	No.	(%)
..#8 Segment Basin.....	2,587	2,898	3,265	4,086	311	12.0	367	12.7	821	25.1
..Lyon County.....	174	190	214	253	16	9.2	24	12.6	39	18.2
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	174	190	214	253	16	-	24	-	39	-
..Farm.....	40	43	50	59	3	-	7	-	9	-
..Non-Farm.....	134	147	164	194	13	-	17	-	30	-
..Caldwell County....	2,375	2,669	3,010	3,789	294	12.4	341	12.8	779	26.0
..Urban.....	1,956	2,224	2,537	3,194	268	-	313	-	657	-
..Rural.....	419	445	473	595	26	-	28	-	122	-
..Farm.....	138	147	156	196	9	-	9	-	40	-
..Non-Farm.....	281	298	317	399	17	-	19	-	82	-
..Trigg County.....	38	39	41	44	1	2.6	2	5.1	3	7.3
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	38	39	41	44	1	-	2	-	3	-
..Farm.....	12	13	13	14	1	-	0	-	1	-
..Non-Farm.....	26	26	28	30	0	-	2	-	2	-
..#9 Segment Basin.....	1,104	1,143	1,207	1,438	39	3.5	64	5.6	231	19.1
..Caldwell County....	324	345	366	461	21	6.5	21	6.1	95	26.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	324	345	366	461	21	-	21	-	95	-
..Farm.....	107	114	121	152	7	-	7	-	31	-
..Non-Farm.....	217	231	245	308	14	-	14	-	64	-
..Trigg County.....	538	552	570	612	14	2.6	18	3.3	42	7.4
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	538	552	570	612	14	-	18	-	42	-
..Farm.....	172	176	182	196	4	-	6	-	14	-
..Non-Farm.....	366	376	388	416	10	-	12	-	28	-
..Christian County...	242	246	271	365	4	2.0	25	10.0	94	35.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	242	246	271	365	4	-	25	-	94	-
..Farm.....	73	74	81	109	1	-	7	-	28	-
..Non-Farm.....	169	172	190	256	3	-	18	-	66	-
..#10 Segment Basin....	2,279	2,331	2,465	2,925	52	2.3	138	5.9	456	18.5
..Trigg County.....	1,383	1,420	1,465	1,572	37	2.7	45	3.2	107	7.3
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	1,383	1,420	1,465	1,572	37	-	45	-	107	-
..Farm.....	443	455	469	503	12	-	14	-	34	-
..Non-Farm.....	940	966	996	1,069	26	-	30	-	73	-
..Christian County...	896	911	1,004	1,353	15	2.0	93	10.0	349	35.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	896	911	1,004	1,353	15	-	93	-	349	-
..Farm.....	269	273	301	406	4	-	28	-	105	-
..Non-Farm.....	627	638	703	947	11	-	65	-	244	-
..#11 Segment Basin....	871	888	965	1,244	17	2.0	77	8.7	279	29.0
..Trigg County.....	192	198	204	219	6	3.1	6	3.0	15	7.4
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	192	198	204	219	6	-	6	-	15	-
..Farm.....	62	63	65	70	1	-	2	-	5	-
..Non-Farm.....	130	135	139	149	5	-	4	-	10	-

(con't) Exhibit A-3.4t: Basin-Housing Units Trends and Projections, "At-Year" and "Between-Year" Changes

Segment Breakdown	Housing Units "At-Year"				Housing Unit Number and Percentage Changes "Between-Year"					
					1970-1975		1975-1980		1980-1995	
	1970	1975	1980	1995	No.	(%)	No.	(%)	No.	(%)
..Christian County...	679	690	761	1,025	11	2.0	71	10.0	264	35.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	679	690	761	1,025	11	-	71	-	264	-
..Farm.....	204	207	228	307	3	-	21	-	79	-
..Non-Farm.....	475	483	533	718	8	-	50	-	185	-
..#12 Segment Basin....	387	393	433	583	6	2.0	40	10.0	150	35.0
..Christian County...	387	393	433	583	6	2.0	40	10.0	150	35.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	387	393	433	583	6	-	40	-	150	-
..Farm.....	116	118	130	175	2	-	12	-	45	-
..Non-Farm.....	271	275	303	408	4	-	28	-	105	-
..#13 Segment Basin....	5,991	6,866	7,567	10,196	875	15.0	701	10.0	2,629	35.0
..Christian County...	5,991	6,866	7,567	10,196	875	15.0	701	10.0	2,629	35.0
..Urban.....	5,528	6,396	7,050	9,500	868	-	654	-	2,450	-
..Rural.....	463	470	517	696	7	-	47	-	179	-
..Farm.....	139	141	155	209	2	-	14	-	54	-
..Non-Farm.....	324	329	362	487	5	-	33	-	125	-
..#14 Segment Basin....	4,212	4,799	5,288	7,121	587	14.0	489	10.2	1,833	35.0
..Christian County...	4,198	4,785	5,274	7,106	587	14.0	489	10.0	1,832	35.0
..Urban.....	3,686	4,264	4,700	6,333	577	-	436	-	1,633	-
..Rural.....	512	522	574	773	10	-	52	-	199	-
..Farm.....	153	156	172	232	3	-	16	-	60	-
..Non-Farm.....	359	366	402	541	7	-	36	-	139	-
..Todd County.....	14	14	14	15	0	0	0	0	1	7.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	14	14	14	15	0	-	0	-	1	-
..Farm.....	4	4	4	4	0	-	0	-	0	-
..Non-Farm.....	10	10	10	11	0	-	0	-	1	-
..#15 Segment Basin....	155	158	173	231	3	2.0	15	10.0	58	34.0
..Christian County...	148	151	166	224	3	2.0	15	10.0	58	35.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	148	151	166	224	3	-	15	-	58	-
..Farm.....	44	45	50	68	1	-	5	-	18	-
..Non-Farm.....	104	106	116	156	2	-	10	-	40	-
..Todd County.....	7	7	7	7	0	0	0	0	0	0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	7	7	7	7	0	-	0	-	0	-
..Farm.....	2	2	2	2	0	-	0	-	0	-
..Non-Farm.....	5	5	5	5	0	-	0	-	0	-
..#16 Segment Basin....	260	264	291	390	4	2.0	27	10.2	99	34.0
..Christian County...	253	257	284	383	4	2.0	27	11.0	99	35.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	253	257	284	383	4	-	27	-	99	-
..Farm.....	76	77	85	115	1	-	8	-	30	-
..Non-Farm.....	177	180	199	268	3	-	19	-	69	-
..Todd County.....	7	7	7	7	0	0	0	0	0	0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	7	7	7	7	0	-	0	-	0	-
..Farm.....	2	2	2	2	0	-	0	-	0	-
..Non-Farm.....	5	5	5	5	0	-	0	-	0	-

(con't) Exhibit A-3.4t: Basin-Housing Units Trends and Projections, "At-Year" and "Between-Year" Changes

Segment Breakdown	Housing Units "At-Year"				Housing Unit Number and Percentage Changes "Between-Year"					
					1970-1975		1975-1980		1980-1995	
	1970	1975	1980	1995	No.	(%)	No.	(%)	No.	(%)
..#17 Segment Basin....	685	686	709	747	1	.14	23	3.4	38	5.4
..Christian County...	22	22	24	32	0	0	2	9.0	8	33.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	22	22	24	32	0	-	2	-	8	-
..Farm.....	7	7	7	9	0	-	0	-	2	-
..Non-Farm.....	15	15	17	23	0	-	2	-	6	-
..Todd County.....	663	664	685	715	1	.15	21	3.2	30	4.4
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	663	664	685	715	1	-	21	-	30	-
..Farm.....	223	224	231	241	1	-	7	-	10	-
..Non-Farm.....	440	440	454	474	0	-	14	-	20	-
..#18 Segment Basin....	465	466	481	506	1	.2	15	3.2	25	5.2
..Christian County...	11	11	12	16	0	0	1	9.0	4	33.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	11	11	12	16	0	-	1	-	4	-
..Farm.....	3	3	4	5	0	-	1	-	1	-
..Non-Farm.....	8	8	8	11	0	-	0	-	3	-
..Todd County.....	454	455	469	490	1	.2	14	3.1	21	4.5
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	454	455	469	490	1	-	14	-	21	-
..Farm.....	146	146	150	157	0	-	4	-	7	-
..Non-Farm.....	308	309	319	333	1	-	10	-	14	-
..#19 Segment Basin....	971	994	1,038	1,134	23	2.4	44	4.4	96	9.2
..Todd County.....	761	761	785	819	0	0	24	3.2	34	4.3
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	761	761	785	819	0	-	24	-	34	-
..Farm.....	251	251	259	270	0	-	8	-	11	-
..Non-Farm.....	510	510	526	549	0	-	16	-	23	-
..Logan County.....	210	233	253	315	23	11.0	20	9.0	62	24.5
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	210	233	253	315	23	-	20	-	62	-
..Farm.....	97	107	116	144	10	-	9	-	28	-
..Non-Farm.....	113	126	137	171	13	-	11	-	34	-
..#20 Segment Basin....	3,053	3,344	3,596	4,392	291	9.5	252	7.5	796	22.0
..Todd County.....	363	363	374	390	0	0	11	3.0	16	4.3
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	363	363	374	390	0	-	11	-	16	-
..Farm.....	120	120	124	129	0	-	4	-	5	-
..Non-Farm.....	243	243	250	261	0	-	7	-	11	-
..Simpson County.....	635	738	790	975	103	16.0	52	7.0	185	23.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	635	738	790	975	103	-	52	-	185	-
..Farm.....	413	479	514	634	66	-	35	-	120	-
..Non-Farm.....	222	259	276	341	37	-	17	-	65	-
..Logan County.....	2,055	2,243	2,432	3,027	188	9.0	189	8.0	595	24.5
..Urban.....	209	196	212	264	-13	-	16	-	52	-
..Rural.....	1,846	2,047	2,220	2,763	201	-	173	-	543	-
..Farm.....	849	941	1,022	1,272	92	-	81	-	250	-
..Non-Farm.....	997	1,106	1,198	1,491	109	-	92	-	293	-

(con't) Exhibit A-3.4t: Basin-Housing Units Trends and Projections, "At-Year" and "Between-Year" Changes

Segment Breakdown	Housing Units "At-Year"				Housing Unit Number and Percentage Changes "Between-Year"					
					1970-1975		1975-1980		1980-1995	
	1970	1975	1980	1995	No.	(%)	No.	(%)	No.	(%)
..#21 Segment Basin....	27	30	33	41	3	11.0	3	10.0	8	24.0
..Logan County.....	27	30	33	41	3	11.0	3	10.0	8	24.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	27	30	33	41	3	-	3	-	8	-
..Farm.....	13	14	15	19	1	-	1	-	4	-
..Non-Farm.....	14	16	18	22	2	-	2	-	4	-
..#22 Segment Basin....	7	8	9	11	1	14.0	1	13.0	2	22.0
..Simpson County.....	7	8	9	11	1	14.0	1	13.0	2	22.0
..Urban.....	0	0	0	0	0	-	0	-	0	-
..Rural.....	7	8	9	11	1	-	1	-	2	-
..Farm.....	5	5	6	7	0	-	1	-	1	-
..Non-Farm.....	2	3	3	4	1	-	0	-	1	-

Appendix A-4: LOWER CUMBERLAND RIVER BASIN DISAGGREGATION OF

EMPLOYMENT TRENDS & PROJECTIONS

INTRODUCTION

Employment projections provide assistance in estimating future wastewater discharges from industry and other places of non-agricultural employment. The projections contained in this appendix were extracted from Appendix A-5 ("The Pennyrile A.D.D. Employment Projections"), and from similar figures developed for the Barren River A.D.D. by Roy Weston, Incorporated.

The largest share of future employment growth is projected for Christian County (see Exhibit A-4m) in and around the City of Hopkinsville. When the county totals are disaggregated to the L.C.R.B. segment basins, as shown by Exhibit A-4.1t, the basin with the largest growth (#14) represents part of the Hopkinsville area.

Exhibit A-4.2t shows projections for the nine L.C.R.B. counties, in-and-out of basin, and basin segments. Counties having all their projected growth within one segment also were assumed to contain all existing employment. No figures were available, however, to distribute existing employment where future growth was projected to occur in two or more segments within a county. Exhibit A-4.3t arranges the projections by segment basins.

Exh. A-4.1t: Projected Employment "Growth" by Segment

L.C.R.B. Segment Basin	1975-1980	1980-1995
#1 segment basin	0	0
#2 segment basin	0	0
#3 segment basin	0	0
#4 segment basin	0	0
#5 segment basin	0	0
#6 segment basin	185	310
#7 segment basin	0	0
#8 segment basin	1,301	1,770
#9 segment basin	0	0
#10 segment basin	439	637
#11 segment basin	215	315
#12 segment basin	0	0
#13 segment basin	599	1,021
#14 segment basin	4,891	6,996
#15 segment basin	0	0
#16 segment basin	0	0
#17 segment basin	0	0
#18 segment basin	134	192
#19 segment basin	296	439
#20 segment basin	0	0
#21 segment basin	0	0
#22 segment basin	0	0
Total	8,061	11,689

Exhibit A-4m: Employment Projections For the Lower Cumberland River Basin Counties

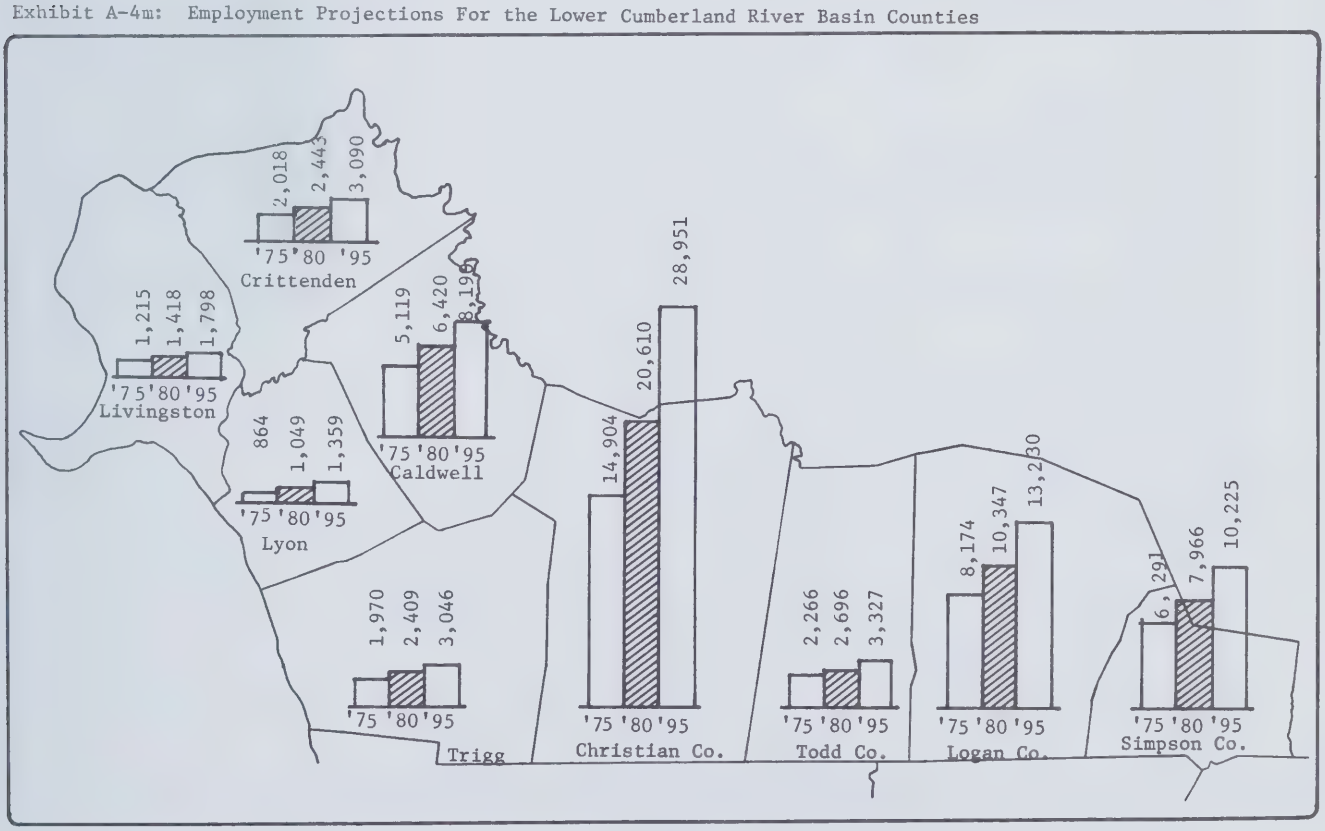


Exhibit A-4.2t: County Employment Projections

Area Breakdown And Employment Category	"At-Year" Number			Number Change		Percent Change	
	1975	1980	1995	1975-80	1980-95	1975-80	1980-95
NINE-COUNTY TOTAL	42,821	55,358	73,216	12,537	17,858	29.27	32.25
Manufacturing total	18,010	24,431	32,160	6,421	7,729	35.65	31.64
Food & kindred	519	626	753	107	127	20.62	20.29
Tobacco	203	246	300	43	54	21.18	21.95
Clothing, textile, leather	4,344	5,981	7,494	1,637	1,513	37.68	25.30
Lumber & furniture	713	835	976	122	141	17.11	16.89
Print., publish., paper	318	348	423	30	75	9.43	21.55
Chem. petrol., coal, rubber	1,766	2,540	3,602	774	1,062	43.83	41.81
Stone, clay, glass	117	141	146	24	5	20.51	3.55
Primary metals	1,451	1,993	2,865	542	872	37.35	43.75
Mach., metal prod., equip.	8,169	11,200	14,896	3,031	3,696	37.10	33.00
Other	409	522	704	113	182	27.63	34.87
Non-Manufacturing total	24,811	30,937	41,056	6,126	10,119	24.69	32.71
Mining & Quarrying	642	871	1,103	229	232	35.67	26.64
Construction	1,630	1,975	2,501	345	526	21.17	26.63
Trans., comm., util., & R.R.	1,500	1,549	1,683	49	134	3.27	8.65
Wholesale-retail trade	7,927	9,050	10,693	1,123	1,643	14.17	18.15
Finance, insurance, & real estate	1,454	1,722	2,600	268	878	18.43	50.99
Services	3,390	5,848	9,500	2,458	3,652	72.51	62.45
Government	8,268	9,921	12,976	1,653	3,055	19.99	30.79
..Outside LCRB	17,698	22,174	28,343	4,476	6,169	25.29	27.82
Manufacturing total	8,859	11,599	14,831	2,740	3,232	30.93	27.86
Food & kindred	347	454	581	107	127	30.84	27.97
Tobacco	116	152	193	36	41	31.03	26.97
Clothing, textile, leather	1,633	2,142	2,733	509	591	31.17	27.59
Lumber & furniture	415	537	678	122	141	29.40	26.26
Print., publish., paper	240	266	319	26	53	10.83	19.92
Chem. petrol, coal, rubber	1,310	1,716	2,190	406	474	30.99	27.62
Stone, clay, glass	50	63	79	13	16	26.00	25.40
Primary metals	561	734	937	173	203	30.84	27.66
Mach., metal prod., equip.	3,972	5,255	6,763	1,283	1,508	32.30	28.70
Other	214	279	357	65	78	30.37	27.96
Non-Manufacturing total	8,839	10,575	13,512	1,746	2,927	19.75	27.68
Mining & Quarrying	353	432	562	79	130	22.38	30.09
Construction	835	1,023	1,369	188	346	22.51	33.82
Trans., comm., util., & R.R.	461	509	590	48	81	10.41	15.91
Wholesale-retail trade	3,153	3,760	4,414	607	654	19.25	17.39
Finance, insurance & real estate	424	496	694	72	198	16.98	39.92
Services	998	1,313	2,004	315	691	31.56	52.63
Government	2,615	3,052	3,879	437	827	16.71	27.10
..Inside LCRB	25,128	33,184	44,873	8,061	11,689	32.08	35.27
Manufacturing total	9,151	12,832	17,329	3,681	4,497	40.23	35.05
Food & kindred	172	172	172	0	0	0	0
Tobacco	87	94	107	7	13	4.07	13.83
Clothing, textile, leather	2,711	3,839	4,761	1,128	922	41.61	24.02
Lumber & furniture	298	298	298	0	0	0	0
Print., publish., paper	78	82	104	4	22	5.13	26.83
Chem. petrol., coal, rubber	456	824	1,412	368	588	80.70	71.36
Stone, clay, glass	67	67	67	0	0	0	0
Primary metals	890	1,259	1,928	369	669	41.46	53.14
Mach., metal prod., equip.	4,197	5,945	8,133	1,748	2,188	41.65	36.80
Other	195	243	347	48	104	24.62	42.80
Non-Manufacturing total	15,972	20,352	27,544	4,380	7,192	27.42	35.34
Mining & quarrying	289	439	541	150	102	51.90	18.92
Construction	795	952	1,132	157	180	19.75	18.91
Trans., comm., util., & R.R.	1,039	1,040	1,093	1	53	.10	5.10
Wholesale-retail trade	4,774	5,290	6,279	516	989	10.81	18.70
Finance, insurance & real estate	1,030	1,226	1,906	196	680	19.03	55.46
Services	2,392	4,535	7,496	2,143	2,961	89.59	65.29
Government	5,653	6,869	9,097	1,216	2,228	21.51	32.44

(continuation) Exhibit A-4.2t: County Employment Projections

Area Breakdown and Employment Category	"At-Year" Number			Number Change		Percent Change	
	1975	1980	1995	1975-80	1980-95	1975-80	1980-95
..LIVINGSTON CO. TOTAL	1,215	1,418	1,798	203	380	16.71	26.80
..Outside LCRB	1,215	1,418	1,798	203	380	16.71	26.80
Manufacturing total	25	25	25	0	0	0	0
Food & kindred	-	-	-	-	-	-	-
Tobacco	-	-	-	-	-	-	-
Clothing, textile, leather	-	-	-	-	-	-	-
Lumber & furniture	24	24	24	0	0	0	0
Print., publish., paper	-	-	-	-	-	-	-
Chem., petrol., coal, rubber	-	-	-	-	-	-	-
Stone, clay, glass	-	-	-	-	-	-	-
Primary metals	-	-	-	-	-	-	-
Mach., metal prod., equip.	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-
Non-Manufacturing total	1,190	1,403	1,773	203	380	17.06	27.28
Mining & Quarrying	234	291	375	47	94	20.09	33.45
Construction	64	71	80	7	9	10.94	12.68
Trans., comm., util., & R.R.	76	76	79	0	3	0	3.95
Wholesale-retail trade	138	148	167	10	19	7.24	12.84
Finance, insurance & real estate	103	117	162	14	45	13.59	38.46
Services	139	206	301	67	95	48.20	46.12
Government	436	494	609	58	115	13.30	23.28
..Inside LCRB	-	-	-	-	-	-	-
..#1 Segment Basin	-	-	-	-	-	-	-
..#2 Segment Basin	-	-	-	-	-	-	-
..#3 Segment Basin	-	-	-	-	-	-	-
..#4 Segment Basin	-	-	-	-	-	-	-
..#5 Segment Basin	-	-	-	-	-	-	-
..CRITTENDEN CO. TOTAL	2,018	2,443	3,090	425	647	21.06	26.48
..Outside LCRB (north)	2,018	2,443	3,090	425	647	21.06	26.48
Manufacturing total	780	1,022	1,338	242	316	31.03	30.92
Food & kindred	-	-	-	-	-	-	-
Tobacco	-	-	-	-	-	-	-
Clothing, textile, leather	-	-	-	-	-	-	-
Lumber & furniture	-	-	-	-	-	-	-
Print., publish., paper	184	194	227	10	33	5.43	17.01
Chem., petrol., coal, rubber	-	-	-	-	-	-	-
Stone, clay,glass	8	8	8	0	0	0	0
Primary metals	-	-	-	-	-	-	-
Mach. metal prod., & equip.	588	820	1,103	232	283	39.45	34.51
Other	-	-	-	-	-	-	-
Non-Manufacturing total	1,238	1,421	1,752	183	331	14.78	23.29
Mining & Quarrying	71	85	114	14	29	19.72	34.12
Construction	74	83	93	9	10	12.16	12.04
Trans., comm., util., & R.R.	85	85	88	0	3	0	3.52
Wholesale,retail trade	337	360	406	23	46	6.82	12.78
Finance, insurance, real estate	58	67	92	9	25	15.52	37.31
Services	134	198	290	64	92	47.76	46.46
Government	479	543	669	64	126	13.36	23.20
..Inside LCRB	-	-	-	-	-	-	-
..#1 Segment Basin	-	-	-	-	-	-	-
..#2 Segment Basin	-	-	-	-	-	-	-
..#3 Segment Basin	-	-	-	-	-	-	-

(continuation) Exhibit A-4.2t: County Employment Projections

Area Breakdown and Employment Category	"At-Year" Number			Number Change		Percent Change	
	1975	1980	1995	1975-80	1980-95	1975-80	1980-95
..LYON CO. TOTAL	864	1,049	1,359	185	310	21.41	29.55
..Outside LCRB	-	-	-	-	-	-	-
..Inside LCRB	864	1,049	1,359	185	310	21.41	29.55
..#6 Segment Basin	864	1,049	1,359	185	310	21.41	29.55
Manufacturing total	228	315	448	87	133	38.16	42.22
Food & kindred	-	-	-	-	-	-	-
Tobacco	-	-	-	-	-	-	-
Clothing, textile, leather	-	-	-	-	-	-	-
Lumber & furniture	-	-	-	-	-	-	-
Printing, publish., paper	-	-	-	-	-	-	-
Chem., petrol., coal, rubber	222	309	442	87	133	39.19	43.04
Stone, clay, glass	6	6	6	0	0	0	0
Primary metals	-	-	-	-	-	-	-
Mach., metal prod., equip.	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-
Non-Manufacturing total	636	734	911	98	177	15.41	24.11
Mining & quarrying	-	-	-	-	-	-	-
Construction	44	49	55	5	6	11.36	12.24
Trans., comm., util., & R.R.	8	8	8	0	0	0	0
Wholesale-retail trade	118	126	142	8	16	6.78	12.70
Finance, insurance, real estate	32	37	51	5	14	15.62	37.84
Services	61	91	133	30	42	49.18	46.15
Government	373	423	522	50	99	13.40	23.40
..#3 Segment Basin	-	-	-	-	-	-	-
..#4 Segment Basin	-	-	-	-	-	-	-
..#5 Segment Basin	-	-	-	-	-	-	-
..#7 Segment Basin	-	-	-	-	-	-	-
..#8 Segment Basin	-	-	-	-	-	-	-
..CALDWELL CO. TOTAL	5,119	6,420	8,190	1,301	1,770	25.42	27.57
..Outside LCRB	-	-	-	-	-	-	-
..Inside LCRB	5,119	6,420	8,190	1,301	1,770	25.42	27.57
..#8 Segment Basin	5,119	6,420	8,190	1,301	1,770	25.42	27.57
Manufacturing total	2,445	3,313	4,332	868	1,019	35.50	30.76
Food & kindred	14	14	14	0	0	0	0
Tobacco	-	-	-	-	-	-	-
Clothing, textile, leather	533	681	815	148	134	27.77	19.68
Lumber & furniture	55	55	55	0	0	0	0
Print., publish, paper	12	13	15	1	2	8.33	15.38
Chem., petrol., coal, rubber	8	11	16	3	5	37.50	45.45
Stone, clay, glass	-	-	-	-	-	-	-
Primary metals	-	-	-	-	-	-	-
Machinery, metal prod., equip.	1,823	2,539	3,417	716	878	39.27	34.58
Other	-	-	-	-	-	-	-
Non-Manufacturing total	2,674	3,107	3,858	433	751	16.19	24.17
Mining & quarrying	120	145	193	25	48	20.83	33.10
Construction	164	183	205	19	22	11.58	12.02
Trans., comm., util., R.R.	260	260	268	0	8	0	3.07
Wholesale-retail trade	708	756	852	48	96	6.77	12.70
Finance, insurance, real estate	105	120	166	15	46	14.28	38.33
Services	431	638	934	207	296	48.02	46.39
Government	886	1,005	1,240	119	235	13.43	23.38
..#3 Segment Basin	-	-	-	-	-	-	-
..#5 Segment Basin	-	-	-	-	-	-	-
..#9 Segment Basin	-	-	-	-	-	-	-

(continuation) Exhibit A-4.2t: County Employment Projections

Area Breakdown and Employment Category	"At-Year" Number			Number Change		Percent Change	
	1975	1980	1995	1975-80	1980-95	1975-80	1980-95
..TRIGG CO. TOTAL	1,970	2,409	3,046	439	637	22.28	26.44
..Outside LCRB	-	-	-	-	-	-	-
..Inside LCRB	1,970	2,409	3,046	439	637	22.28	26.44
..#10 Segment Basin	1,970	2,409	3,046	439	637	22.28	26.44
Manufacturing total	625	832	1,066	207	234	33.12	28.13
Food & kindred	12	12	12	0	0	0	0
Tobacco	-	-	-	-	-	-	-
Clothing, textile, leather	223	285	341	62	56	27.80	21.75
Lumber & furniture	20	20	20	0	0	0	0
Print., publish., paper	2	2	3	0	0	0	50.00
Chem., petrol., coal, rubber	-	-	-	-	-	-	-
Stone, clay, glass	-	-	-	-	-	-	-
Primary metals	-	-	-	-	-	-	-
Mach. metal, prod. & equip.	368	513	690	145	177	39.40	34.70
Other	-	-	-	-	-	-	-
Non-Manufacturing total	1,345	1,577	1,980	232	403	17.25	25.55
Mining & Quarrying	-	-	-	-	-	-	-
Construction	105	117	131	12	14	11.43	11.96
Trans., comm., util., & R.R.	45	45	47	0	2	0	4.44
Wholesale-retail trade	277	295	333	18	38	6.50	12.88
Finance, insurance, real estate	42	47	66	5	19	11.90	40.42
Services	231	341	500	10	59	4.33	17.30
Government	645	732	903	87	171	13.49	23.36
..#5 Segment Basin	-	-	-	-	-	-	-
..#8 Segment Basin	-	-	-	-	-	-	-
..#9 Segment Basin	-	-	-	-	-	-	-
..#11 Segment Basin	-	-	-	-	-	-	-
..CHRISTIAN CO. TOTAL	14,904	20,610	28,951	5,706	8,341	38.29	40.47
..Outside LCRB (north)	-	-	-	-	-	-	-
..Inside LCRB	14,904	20,610	28,951	5,706	8,341	38.29	40.47
Manufacturing total	4,984	7,258	10,085	2,274	2,827	45.63	38.95
Food & kindred	146	146	146	0	0	0	0
Tobacco	87	94	107	7	13	8.04	13.83
Clothing, textile, leather	1,550	2,356	2,987	806	631	52.00	26.78
Lumber & furniture	97	97	97	0	0	0	0
Printing, publish., paper	64	67	86	3	19	4.69	28.36
Chem., petrol., coal, rubber	219	495	941	276	446	126.03	90.10
Stone, clay, glass	61	61	61	0	0	0	0
Primary metals	793	1,123	1,725	330	602	41.61	53.60
Machinery, metal prod.	1,772	2,567	3,588	804	1,012	45.37	39.28
Other	195	243	347	48	104	24.61	42.80
Non-Manufacturing total	9,920	13,352	18,866	3,432	5,514	34.60	41.30
Mining & quarrying	159	282	332	123	50	77.36	17.73
Construction	462	580	715	118	135	25.54	23.27
Trans., comm., util., & R.R.	643	644	684	1	40	0.15	6.21
Wholesale-retail trade	3,188	3,598	4,371	410	773	12.86	21.48
Finance, insurance, real estate	799	963	1,541	164	578	20.52	60.02
Services	1,551	3,291	5,674	1,740	2,383	112.85	72.41
Government	3,118	3,993	5,549	875	1,556	28.06	38.97

(continuation) Exhibit A-4.2t: County Employment Projections

Area Breakdown and Employment Category	"At-Year" Number			Number Change		Percent Change	
	1975	1980	1995	1975-80	1980-95	1975-80	1980-95
..#11 Segment Basin	(see footnote*)			215	315	(See footnote*)	
Manufacturing total				-	-		
Food & kindred				-	-		
Tobacco				-	-		
Clothing, textile, leather				-	-		
Lumber & furniture				-	-		
Printing, publish., paper				-	-		
Chem., petrol., coal, rubber				-	-		
Stone, clay, glass				-	-		
Primary metals				-	-		
Mach., metal prod., & equip.				-	-		
Other				-	-		
Non-Manufacturing total				215	315		
Mining & Quarrying				-	-		
Construction				-	-		
Trans., comm., util. & R.R.				-	-		
Wholesale-retail trade				41	77		
Finance, insurance, real estate				-	-		
Services				174	238		
Government				-	-		
..#13 Segment Basin	(see footnote*)			599	1,021	(see footnote*)	
Manufacturing total				126	233		
Food & kindred				-	-		
Tobacco				-	-		
Cloth, text., leather				-	-		
Lumber & furniture				106	200		
Print., pub., paper				-	-		
Chem., pet., coal, rubber				-	-		
Stone, clay, glass				-	-		
Primary metals				-	-		
Mach., met. prod., equip.				-	-		
Other				20	24		
Non-Manufacturing total				473	788		
Mining & quarrying				18	25		
Construction				-	-		
Trans., comm., util., R.R.				-	-		
Wholesale, retail trade				41	123		
Finance, insurance, real estate				14	78		
Services				200	262		
Government				200	300		
..#14 Segment Basin	(see footnote*)			4,891	6,996	(see footnote*)	
Manufacturing total				2,148	2,594		
Food & kindred				-	-		
Tobacco				7	13		
Cloth., text., leather				700	431		
Lumber & furn.				-	-		
Print., pub., paper				3	10		
Chem., pet., coal, rubber				276	446		
Stone, clay, glass				-	-		
Primary metals				330	602		
Mach., met. prod., equip.				804	1,012		
Other				28	80		
Non-Manufacturing total				2,743	4,402		
Mining & quarrying				123	50		
Construction				100	110		
Trans., comm., util., R.R.				1	40		
Wholesale, retail trade				328	573		
Finance, insurance, real estate				150	500		
Services				1,366	1,883		
Government				675	1,256		

*Segment figures not included because existing employment is not available by segment.

(continuation) Exhibit A-4.2t: County Employment Projections

Area Breakdown and Employment Category	"At-Year" Number			Number Change		Percent Change	
	1975	1980	1995	1975-80	1980-95	1975-80	1980-95
..continuation of Christian County							
..#9 Segment Basin	-	-	-	-	-	-	-
..#10 Segment Basin	-	-	-	-	-	-	-
..#12 Segment Basin	-	-	-	-	-	-	-
..#15 Segment Basin	-	-	-	-	-	-	-
..#16 Segment Basin	-	-	-	-	-	-	-
..#17 Segment Basin	-	-	-	-	-	-	-
..#18 Segment Basin	-	-	-	-	-	-	-
..TODD COUNTY TOTAL	2,266	2,696	3,327	430	631	18.98	23.41
..Outside LCRB (north)	-	-	-	-	-	-	-
..Inside LCRB	2,266	2,696	3,327	430	631	18.98	23.41
Manufacturing total	869	1,114	1,398	245	284	28.19	25.49
Food & kindred	-	-	-	-	-	-	-
Tobacco	-	-	-	-	-	-	-
Clothing, textile, leather	405	517	618	112	101	27.65	19.53
Lumber & furniture	126	126	126	0	0	0	0
Print., publish., paper	-	-	-	-	-	-	-
Chem., petrol., coal, rubber	7	9	13	2	4	28.57	44.44
Stone, clay, glass	-	-	-	-	-	-	-
Primary metals	97	136	203	39	67	40.20	49.26
Mach. metal prod. & equip.	234	326	438	92	112	39.31	34.35
Other	-	-	-	-	-	-	-
Non-Manufacturing total	1,397	1,582	1,929	185	347	13.24	21.93
Mining & quarrying	10	12	16	2	4	20.00	33.33
Construction	20	23	26	3	3	15.00	13.04
Trans., comm., util., & R.R.	83	83	86	0	3	0	3.61
Wholesale-retail trade	483	515	581	32	66	6.62	12.81
Finance, insurance & real estate	52	59	82	7	23	13.46	38.98
Services	118	174	255	56	81	47.46	46.55
Government	631	716	883	85	167	13.47	23.32
..#18 Segment Basin	(see footnote*)			134	192	(see footnote*)	
Manufacturing total				83	80		
Food & kindred				-	-		
Tobacco				-	-		
Clothing, text., leather				42	21		
Lumber, furn.				-	-		
Print., pub., paper				-	-		
Chem., pet., coal, rubber				-	-		
Stone, clay, glass				-	-		
Primary metals				9	27		
Mach., met. prod., equip.				32	32		
Other				-	-		
Non-Manufacturing total				51	112		
Mining & quarrying				-	-		
Construction				-	-		
Trans., comm., util., R.R.				-	-		
Wholesale-retail trade				12	26		
Finance, insurance, real estate				3	8		
Services				26	31		
Government				10	47		

*Segment figures not included because existing employment is not available by segment.

(continuation) Exhibit 4.2t: County Employment Projections

Area Breakdown and Employment Category	"At-Year" Number			Number Change		Percent Change	
	1975	1980	1995	1975-80	1980-95	1978-80	1980-95
..continuation of Todd county							
..#19 Segment Basin	(see footnote*)			296	439	(see footnote*)	
Manufacturing total				162	204		
Food & kindred				-	-		
Tobacco				-	-		
Clothing, text., leather				70	80		
Lumber, furn.				-	-		
Print., pub., paper				-	-		
Chem., pet., coal, rubber				2	4		
Stone, clay, glass				-	-		
Primary metals				30	40		
Mach., metal. prod., equip.				60	80		
Other				-	-		
Non-Manufacturing total				134	235		
Mining & quarrying				2	4		
Construction				3	3		
Trans., comm., util., R.R.				-	3		
Wholesale-retail trade				20	40		
Finance, insurance, real estate				4	15		
Services				30	50		
Government				75	120		
..#14 Segment Basin	-	-	-	-	-	-	-
..#15 Segment Basin	-	-	-	-	-	-	-
..#16 Segment Basin	-	-	-	-	-	-	-
..#17 Segment Basin	-	-	-	-	-	-	-
..#20 Segment Basin	-	-	-	-	-	-	-
..LOGAN COUNTY TOTAL	8,174	10,347	13,230	2,173	2,883	26.58	27.86
..Outside LCRB (north)	8,174	10,347	13,230	2,173	2,883	26.58	27.86
Manufacturing total	4,689	6,145	7,842	1,456	1,697	31.05	27.62
Food & kindred	313	410	524	97	114	30.99	27.80
Tobacco	19	25	31	6	6	31.58	24.00
Clothing, text., leather	1,288	1,689	2,155	401	466	31.13	27.59
Lumber, furn.	391	513	654	122	141	31.20	27.49
Print., pub., paper	25	32	41	7	9	28.00	28.13
Chem., pet., coal, rubber	219	287	366	68	79	31.05	27.53
Stone, clay, glass	26	34	44	8	10	30.77	29.41
Primary metals	536	702	896	166	194	30.97	27.64
Mach., met. prod., equip.	1,712	2,244	2,864	532	620	31.07	27.63
Other	160	209	267	49	58	30.63	27.75
Non-Manufacturing total	3,485	4,202	5,388	717	1,186	20.75	28.22
Mining & quarrying	35	41	53	6	12	17.14	29.27
Construction	184	229	315	45	86	24.46	37.55
Trans., comm., util., R.R.	179	207	252	28	45	15.64	21.75
Wholesale, retail trade	1,396	1,695	2,002	299	307	21.42	18.11
Finance, insurance, real estate	167	198	279	31	81	18.56	40.91
Services	371	465	723	94	258	25.34	55.48
Government	1,153	1,367	1,764	214	397	18.56	29.04
..Inside LCRB	-	-	-	-	-	-	-
..#19 Segment Basin	-	-	-	-	-	-	-
..#20 Segment Basin	-	-	-	-	-	-	-
..#21 Segment Basin	-	-	-	-	-	-	-

*Segment figures not included because existing employment is not available by segment.

(continuation) Exhibit A-4.2t: County Employment Projections

Area Breakdown and Employment Category	"At-Year" Number			Number Change		Percent Change	
	1975	1980	1995	1975-80	1980-95	1975-80	1980-95
..SIMPSON COUNTY TOTAL	6,291	7,966	10,225	1,675	2,259	26.63	28.36
..Outside LCRB	6,291	7,966	10,225	1,675	2,259	26.63	28.36
Manufacturing total	3,365	4,407	5,626	1,042	1,219	30.97	27.66
Food & kindred	34	44	57	10	13	29.41	29.55
Tobacco	97	127	162	30	35	30.93	27.56
Clothing, text., leather	345	453	578	108	125	31.30	27.59
Lumber, furn.	0	0	0	0	0	0	0
Print., pub., paper	31	40	51	9	11	29.03	27.50
Chem., pet., coal, rubber	1,091	1,429	1,824	338	395	30.98	27.64
Stone, clay, glass	16	21	27	5	6	31.25	28.57
Primary metals	25	32	41	7	9	28.00	28.13
mach., met. prod., equip.	1,672	2,191	2,796	519	605	31.04	27.61
Other	54	70	90	16	20	29.63	28.57
Non-Manufacturing total	2,926	3,559	4,599	633	1,040	21.63	29.22
Mining & quarrying	13	15	20	2	5	15.38	33.33
Construction	513	640	881	127	241	24.76	37.66
Trans., comm. util., R.R.	121	141	171	20	31	16.53	21.99
Wholesale, retail trade	1,282	1,557	1,839	275	282	21.45	18.11
Finance, insurance, real estate	96	114	161	18	47	18.75	41.23
Servcies	354	444	690	90	246	25.42	55.41
Government	547	648	837	101	189	18.46	29.17
..Inside LCRB	-	-	-	-	-	-	-
..#20 Segment Basin	-	-	-	-	-	-	-
..#22 Segment Basin	-	-	-	-	-	-	-

Exhibit A-4.3t: Basin Employment Projections

Area Breakdown and Employment Category	"At-Year" Number			Number Change		Percent Change	
	1975	1980	1995	1975-80	1980-95	1975-80	1980-95
LOWER CUMBERLAND RIVERBASIN*	25,123	33,184	44,873	8,061	11,689	32.08	35.22
Manufacturing total	9,151	12,832	17,329	3,681	4,497	40.23	35.05
Food & kindred	172	172	172	0	0	0	0
Tobacco	87	94	107	7	13	4.07	13.83
Clothing, Textile, leather	2,711	3,839	4,761	1,128	922	41.61	24.02
Lumber & furniture	298	298	298	0	0	0	0
Print., publish., paper	78	82	104	4	22	5.13	26.83
Chem., petrol., coal, rubber	456	824	1,412	368	588	80.70	71.36
Stone, clay, glass	67	67	67	0	0	0	0
Primary metals	890	1,259	1,928	369	669	41.46	53.14
Mach., metal prod., equip.	4,197	5,945	8,133	1,748	2,188	41.65	36.80
Other	195	243	347	48	104	24.62	42.80
Non-Manufacturing total	15,972	20,352	27,544	4,380	7,192	27.42	35.34
Mining & quarrying	289	439	541	150	102	51.90	18.92
Construction	795	952	1,132	157	180	19.75	18.91
Trans., comm., util., & R.R.	1,039	1,040	1,093	1	53	.10	5.10
Wholesale, retail trade	4,774	5,290	6,279	516	989	10.81	18.70
Finance, insurance & real est.	1,030	1,226	1,906	196	680	19.03	55.46
Services	2,392	4,535	7,496	2,143	2,961	89.59	65.29
Government	5,653	6,869	9,097	1,216	2,228	21.51	32.44
..#1 Segment Basin total	-	-	-	-	-	-	-
..Livingston County	-	-	-	-	-	-	-
..Crittenden County	-	-	-	-	-	-	-
..#2 Segment Basin total	-	-	-	-	-	-	-
..Livingston County	-	-	-	-	-	-	-
..Crittenden County	-	-	-	-	-	-	-
..#3 Segment Basin total	-	-	-	-	-	-	-
..Crittenden County	-	-	-	-	-	-	-
..Lyon County	-	-	-	-	-	-	-
..Caldwell County	-	-	-	-	-	-	-
..#4 Segment Basin total	-	-	-	-	-	-	-
..Livingston County	-	-	-	-	-	-	-
..Lyon County	-	-	-	-	-	-	-
..#5 Segment Basin total	-	-	-	-	-	-	-
..Livingston County	-	-	-	-	-	-	-
..Lyon County	-	-	-	-	-	-	-
..Caldwell County	-	-	-	-	-	-	-
..Trigg County	-	-	-	-	-	-	-
..#6 Segment Basin total	864	1,049	1,359	185	310	21.41	29.55
..Lyon County	864	1,049	1,359	185	310	21.41	29.55
Manufacturing total	228	315	448	87	133	38.16	42.22
Food & kindred	-	-	-	-	-	-	-
Tobacco	-	-	-	-	-	-	-
Clothing, textile, leather	-	-	-	-	-	-	-
Lumber & furniture	-	-	-	-	-	-	-
Printing, publish., paper	-	-	-	-	-	-	-
Chem., petrol., coal, rubber	222	309	442	87	133	39.19	43.04
Stone, clay, glass	6	6	6	0	0	0	0
Primary metals	-	-	-	-	-	-	-
Mach., metal prod., equip.	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-
Non-Manufacturing total	636	734	911	98	177	15.41	24.11
Mining & quarrying	-	-	-	-	-	-	-
Construction	44	49	55	5	6	11.36	12.24
Trans, comm., util., & R.R.	8	8	8	0	0	0	0
Wholesale,retail trade	118	126	142	8	16	6.78	12.70
Finance, insurance, real est.	32	37	51	5	14	15.62	37.84
Services	61	91	133	30	42	49.18	46.15
Government	373	423	522	50	99	13.40	23.40

*Basin figures taken from Exh. A-4t, since some segments do not have "At-Year" and "Percent" figures.

(continuation) Exhibit A-4.3t: Basin Employment Projections

Area Breakdown and Employment Category	"At-Year" Number			Number Change		Percent Change	
	1975	1980	1995	1975-80	1980-95	1975-80	1980-95
..#7 Segment Basin total	-	-	-	-	-	-	-
..Lyon County	-	-	-	-	-	-	-
..#8 Segment Basin total	5,119	6,420	8,190	1,301	1,770	25.42	27.57
..Lyon County	-	-	-	-	-	-	-
..Trigg County	-	-	-	-	-	-	-
..Caldwell County	5,119	6,420	8,190	1,301	1,770	25.42	27.57
Manufacturing total	2,445	3,313	4,332	868	1,019	35.50	30.76
Food & kindred	14	14	14	0	0	0	0
Tobacco	-	-	-	-	-	-	-
Clothing, textile, leather	533	681	815	148	134	27.77	19.68
Lumber & furniture	55	55	55	0	0	0	0
Print., publish., paper	12	13	15	1	2	8.33	15.38
Chem., petrol., coal, rubber	8	11	16	3	5	37.50	45.45
Stone, clay, glass	-	-	-	-	-	-	-
Primary metals	-	-	-	-	-	-	-
Machinery, metal prod, equip.	1,823	2,539	3,417	716	878	39.27	34.58
Other	-	-	-	-	-	-	-
Non-Manufacturing total	2,674	3,107	3,858	433	751	16.19	24.17
Mining & quarrying	120	145	193	25	48	20.83	33.10
Construction	164	183	205	19	22	11.58	12.02
Trans., comm., util., R.R.	260	260	268	0	8	0	3.07
Wholesale, retail trade	708	756	852	48	96	6.77	12.70
Finance, insurance & real est.	105	120	166	15	46	14.28	38.33
Services	431	638	934	207	296	48.02	46.39
Government	886	1,005	1,240	119	235	13.43	23.38
..#9 Segment Basin total	-	-	-	-	-	-	-
..Caldwell County	-	-	-	-	-	-	-
..Trigg County	-	-	-	-	-	-	-
..Christian County	-	-	-	-	-	-	-
..#10 Segment Basin total	1,970	2,409	3,046	439	637	22.28	26.44
..Christian County	-	-	-	-	-	-	-
..Trigg County	1,970	2,409	3,046	439	637	22.28	26.44
Manufacturing total	625	832	1,066	207	234	33.12	28.13
Food & kindred	12	12	12	0	0	0	0
Tobacco	-	-	-	-	-	-	-
Clothing, textile, leather	223	285	341	62	56	27.80	21.75
Lumber & furniture	20	20	20	0	0	0	0
Print., publish., paper	2	2	3	0	0	0	50.00
Chem., petrol., coal, rubber	-	-	-	-	-	-	-
Stone, clay, glass	-	-	-	-	-	-	-
Primary metals	-	-	-	-	-	-	-
Mach. metal, prod., equip.	368	513	690	145	177	39.40	34.70
Other	-	-	-	-	-	-	-
Non-Manufacturing total	1,345	1,577	1,980	232	403	17.25	25.55
Mining & quarrying	-	-	-	-	-	-	-
Construction	105	117	131	12	14	11.43	11.96
Trans., comm., util., & R.R.	45	45	47	0	2	0	4.44
Wholesale, retail trade	277	295	333	18	38	6.50	12.88
Finance, insurance, real est.	42	47	66	5	19	11.90	40.42
Services	231	341	500	10	59	4.33	17.30
Government	645	732	903	87	171	13.49	23.36

(continuation) Exhibit A-4.3t: Basin Employment Projections

Area Breakdown and Employment Category	"At-Year" Number			Number Change		Percent Change	
	1975	1980	1995	1975-80	1980-95	1975-80	1980-95
..#11 Segment Basin total*	(see footnote*)			215	315	(see footnote*)	
..Trigg County	-	-	-	-	-	-	-
..Christian County*	(see footnote*)			215	315	(see footnote*)	
Manufacturing total				-	-		
Food & kindred				-	-		
Tobacco				-	-		
Clothing, textile, leather				-	-		
Lumber & furniture				-	-		
Printing, publish., paper				-	-		
Chem., petrol., coal, rubber				-	-		
Stone, clay, glass				-	-		
Primary metals				-	-		
Mach., metal prod., equip.				-	-		
Other				-	-		
Non-Manufacturing total				215	315		
Mining & quarrying				-	-		
Construction				-	-		
Trans., comm., util. & R.R.				-	-		
Wholesale, retail trade				41	77		
Finance, insurance, real est.				-	-		
Services				174	238		
Government				-	-		
..#12 Segment Basin total	-	-	-	-	-	-	-
..Christian County	-	-	-	-	-	-	-
..#13 Segment Basin total	(see footnote*)			599	1,021	(see footnote*)	
..Christian County				599	1,021		
Manufacturing total				126	233		
Food & kindred				-	-		
Tobacco				-	-		
Cloth, text., leather				106	200		
Lumber & furniture				-	-		
Print., pub., paper				-	-		
Chem., pet., coal, rubber				-	-		
Stone, clay, glass				-	-		
Primary metals				-	-		
Mach., met. prod., equip.				-	-		
Other				20	24		
Non-Manufacturing total				473	788		
Mining & quarrying				-	-		
Construction				18	25		
Trans., comm., util., R.R.				-	-		
Wholesale, retail trade				41	123		
Finance, insurance, real est.				14	78		
Services				200	262		
Government				200	300		

*Christian County total employment breakdown is included in Exhibit A-4t. "At-Year" and "Percent Change" figures are not included by segment because figures on existing employment by segment are not available. Location of employment "growth" (or change) was estimated by segment with assistance from the Kentucky Department of Commerce.

(continuation) Exhibit A-4.3t: Basin Employment Projections

Area Breakdown and Employment Category	"At-Year Number			Number Change		Percent Change	
	1975	1980	1995	1975-80	1980-95	1975-80	1980-95
..#14 Segment Basin total	(see Christian Co. footnote*)			4,891	6,996	(see Christian Co.*)	
..Todd County	-	-	-	-	-	-	-
..Christian County				4,891	6,996		
Manufacturing total				2,148	2,594		
Food & kindred				-	-		
Tobacco				7	13		
Cloth, text., leather				700	431		
Lumber & furniture				-	-		
Print., pub., paper				3	10		
Chem., pet., coal, rubber				276	446		
Stone, clay, glass				-	-		
Primary metals				330	602		
Mach., met. prod., equip.				804	1,012		
Other				28	80		
Non-Manufacturing total				2,743	4,402		
Mining & quarrying				123	50		
Construction				100	110		
Trans., comm., util., R.R.				1	40		
Wholesale, retail trade				328	573		
Finance, insurance, real est.				150	500		
Services				1,366	1,883		
Government				675	1,256		
..#15 Segment Basin total	-	-	-	-	-	-	-
..Christian	-	-	-	-	-	-	-
..Todd County	-	-	-	-	-	-	-
..#16 Segment Basin total	-	-	-	-	-	-	-
..Christian County	-	-	-	-	-	-	-
..Todd County	-	-	-	-	-	-	-
..#17 Segment Basin total	-	-	-	-	-	-	-
..Christian County	-	-	-	-	-	-	-
..Todd County	-	-	-	-	-	-	-
..#18 Segment Basin total	(see footnote*)			134	192	(see footnote*)	
..Christian County	-	-	-	-	-	-	-
..Todd County				134	192		
Manufacturing total				83	80		
Food & kindred				-	-		
Tobacco				-	-		
Clothing, text., leather				42	21		
Lumber, furniture				-	-		
Print., pub., paper				-	-		
Chem., pet., coal, rubber				-	-		
Stone, clay, glass				-	-		
Primary metals				9	27		
Mach., met. prod., equip.				32	32		
Other				-	-		
Non-Manufacturing total				51	112		
Mining & quarrying				-	-		
Construction				-	-		
Trans., comm., util., R.R.				-	-		
Wholesale, retail trade				12	26		
Finance, insurance, real est.				3	8		
Services				26	31		
Government				10	47		

*Same procedure as described earlier for Christian County.

(continuation) Exhibit A-4.3t: Basin Employment Projections

Area Breakdown and Employment Category	"At-Year" Number			Number Change		Percent Change	
	1975	1980	1995	1975-80	1980-95	1975-80	1980-95
..#19 Segment Basin total	(see footnote*)			296	439	(see footnote*)	
..Logan County	-	-	-	-	-	-	-
..Todd County				296	439		
Manufacturing total				162	204		
Food & kindred				-	-		
Tobacco				-	-		
Clothing, text., leather				70	80		
Lumber, furniture				-	-		
Print., pub., paper				-	-		
Chem., pet., coal, rubber				2	4		
Stone, clay, glass				-	-		
Primary metals				30	40		
Mach., met. prod., equip.				60	80		
Other				-	-		
Non-Manufacturing total				134	235		
Mining & quarrying				2	4		
Construction				3	3		
Trans., comm., util., R.R.				-	3		
Wholesale, retail trade				20	40		
Finance, insurance, real est.				4	15		
Services				30	50		
Government				75	120		
..#20 Segment Basin total	-	-	-	-	-	-	-
..Todd County	-	-	-	-	-	-	-
..Logan County	-	-	-	-	-	-	-
..Simpson County	-	-	-	-	-	-	-
..#21 Segment Basin total	-	-	-	-	-	-	-
..Logan County	-	-	-	-	-	-	-
..#22 Segment Basin total	-	-	-	-	-	-	-
..Simpson County	-	-	-	-	-	-	-

*Same procedure as described in earlier footnote for Christian County

Appendix A-5: PENNYRILE A.D.D. DISAGGREGATION OF

EMPLOYMENT TRENDS & PROJECTIONS

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INTRODUCTION

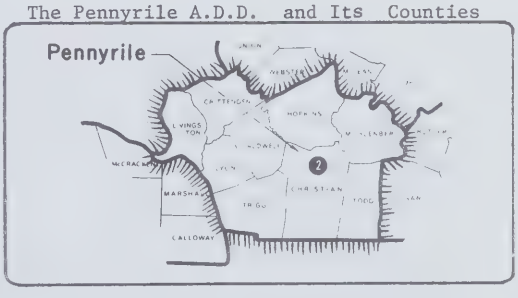
As part of the water quality management planning for the Kentucky River basins, it was necessary to make employment projections for 1975, 1980, and 1995. These projections would assist in estimating future waste water discharges from industry and other places of employment.

For control purposes, all consultants working on Kentucky project decided to use employment projections recently completed by the Ky. Department of Commerce. The Department's projections covered the entire State and the A.D.D.'s for 1980 and 1990, but did not include subdivisions of the manufacturing category. Thus, the consultants had to insert the missing manufacturing subdivisions, interpolate for the projection years, disaggregate the A.D.D. data to each of the A.D.D. counties, and finally disaggregate the county data to the river basins.

In order to expedite this work, it was agreed that the lead consultant in each ADD would make the projections for each county in the ADD, determine the locational distribution of the projected employment within each county, review the work with the Ky. Department of Commerce, and then share this information with other consultants working in the same ADD.

G. Reynolds Watkins Consulting Engineers Inc. was the lead consultant for the Pennyrile A.D.D., and this report is intended to provide other consultants working in the ADD with the required employment projection figures.

The Pennyrile A.D.D. and Its Counties



KENTUCKY STATEWIDE EMPLOYMENT TRENDS AND PROJECTIONS

Trends

The "at year" employment figures of Exhibit A-5t are taken from the Kentucky Department of Commerce report, and were used to derive the other figures.

Projections

The projections of Exhibit A-5.1t are described as follows:

1975 Projections - the 1975 total of 1,099,400 was obtained by adding half of the 1970-1980 growth to the 1970 figure. The remaining breakdown, however was based on the 1970 percentage figures as shown in column #9---with the only exception being that the 1970 figure for "transportation, etc." was reduced by 0.30% (to 6.17%) to prevent a decrease in this category from 1975 to 1980. The 0.30% was added to "services" since it was the fastest growing category. This pushed "services" from 13.12% to 13.42%. Also, in column #2, "machinery, etc." was reduced by 110 (from 116,207 to 116,097) to make t igures add up.

1980 Projections - these figures are from the Kentucky Department of Commerce, except for the manufacturing breakdown. As can be seen from column #10, the 1970 percentage figures were used again, except for adding 0.32% to the "machinery", which is the fastest growing category. The 0.32% comes from manufacturing being projected to increase its relative share of total employment, from 28.61% in 1975 to 28.94% in 1980.

1995 Projections - the 1995 total was obtained by adding half of the 1980-1990 growth (from Dept. of Commerce) to the 1990 projection. The remaining breakdown, however, was based on the 1990 percentage figures (derived from Commerce table) as shown in column #11, except for the manufacturing subcategories. For the manufacturing subcategories, the 1970 percentage figures were used again as much as possible, with slight reductions shown for "food", "clothing", and "lumber", and a slight increase shown for "machinery".

Exhibit A-5t - Non-Agricultural Employment Trends, 1950-1970, For Kentucky

	At Year Number			Number Change		% Change		% of Total		
Employment Category	1950	1960	1970	1950-60	1960-70	1950-60	1960-70	1950	1960	1970
State of Ky. Total	528,098	602,494	885,801	74,396	283,307	14%	47%	100%	100%	100%
Manufacturing total	138,989	171,713	253,417	32,724	81,704	23%	48%	26.3	28.5	28.6
Food & kindred	25,864	26,056	24,695	192	-1,361	1	-5	4.9	4.3	2.8
Tobacco	9,763	11,954	14,233	2,191	2,279	2	19	1.8	1.9	1.6
Clothing, text. leat	22,652	25,687	37,801	3,035	12,114	13	47	4.3	4.3	4.3
Lumber & furn.	17,011	14,484	15,493	-2,527	1,009	-15	7	3.2	2.4	1.7
Print.,publisn,paper	7,283	10,245	17,583	2,962	7,338	41	72	1.4	1.7	1.9
Chem, pet.,coal, rub	7,757	13,455	22,151	5,698	8,696	73	65	1.5	2.2	2.5
Stone,clay,glass	4,532	5,839	7,051	1,307	1,212	29	21	.8	1.0	.8
Primary metals	8,787	8,981	14,435	194	5,454	2	61	1.7	1.5	1.6
Mach,met. prod. &eqp	31,880	52,618	93,394	20,738	40,976	65	78	6.0	8.7	10.6
Other	3,460	2,394	6,380	-1,066	3,986	-31	166	.7	.4	.7
Non-Mfg. total	389,109	430,771	632,384	41,662	201,613	11%	47%	73.7	71.5	71.4
Mining & quarrying	60,917	32,664	28,037	28,253	4,627	-46	-14	11.5	5.4	3.2
Construction	18,357	27,465	40,975	9,108	13,510	50	50	3.5	4.6	4.6
Trans,comm.util,R.R.	59,699	52,059	57,331	7,640	5,272	-13	10	11.3	8.6	6.5
Wholesale-retail trd	122,389	131,851	183,418	9,462	51,567	8	39	23.2	21.9	20.7
Fin.,insur,&real est	15,649	22,619	35,634	6,970	13,015	45	58	3.0	3.8	4.0
Services	37,957	61,742	116,260	23,785	54,518	63	88	7.2	10.2	13.1
Government	74,141	102,371	170,729	28,230	68,358	38	67	14.0	17.0	19.3

Exhibit A-5.1t- Projected Non-Agricultural Employment, 1975-1995, For Kentucky

	At year number			Number change		% of KY. total		
Employment Category	1975	1980	1995	1975-80	1980-95	1975	1980	1995
State of Kentucky total	1,099,400	1,313,000	1,647,000	213,600	334,000	100%	100%	100%
Manufacturing total	314,538	380,000	461,160	65,462	81,160	28.61	28.94	28.00
Food & kindred	30,673	36,764	38,540	6,091	1,776	2.79	2.79	2.34
Tobacco	17,700	21,008	26,517	3,308	5,509	1.61	1.61	1.61
Clothing,text.,leat.	46,944	56,459	65,386	9,515	8,927	4.27	4.27	3.97
Lumber & furniture	19,240	22,321	23,882	3,081	1,561	1.75	1.75	1.45
Print.,publish.,paper	21,768	24,947	32,611	3,179	7,664	1.98	1.98	1.98
Chem.petrol,coal, rub.	27,485	32,825	41,175	5,340	8,350	2.50	2.50	2.50
Stone,clay,glass	8,795	10,504	13,176	1,709	2,672	.80	.80	.80
Primary metals	17,920	21,008	26,846	3,088	5,838	1.63	1.63	1.63
Machinery, met. prod.	116,097	144,973	181,169	28,876	36,196	10.57	10.89	11.00
Other	7,916	9,191	11,858	1,275	2,667	.72	.72	.72
Non-Mfg. total	784,862	933,000	1,185,840	148,138	252,840	71.39	71.06	72.00
Mining & quarrying	34,851	42,000	55,833	7,149	13,833	3.17	3.20	3.39
Construction	50,902	65,000	80,374	14,098	15,374	4.63	4.95	4.88
Trans.,comm.util,& R.R.	67,833	70,000	81.526	2,167	11,526	6.17	5.33	4.95
Wholesale-ret.trade	227,686	251,000	294,813	23,314	43,813	20.71	19.12	17.90
Finance,insur.,&real	44,196	50,000	67,527	5,804	17,527	4.02	3.81	4.10
Services	147,540	208,000	292,672	60,460	84,672	13.42	15.84	17.77
Government	211,854	247,000	313,095	35,146	66,095	19.27	18.81	19.01

PENNYRILE A.D.D. EMPLOYMENT TRENDS AND PROJECTIONS

Employment Trends

The "at-year" employment figures of Exhibit A-5.2t are taken from from the Ky. Department of Commerce report, "Employment Trends, 1950-1970, Kentucky Non-Agricultural Wage and Salary (Excluding data not classified by County)." Other figures are derived from "at-year" employment.

As shown by the exhibits, non-manufacturing employment has accounted for over three-fourths of the total --- although manufacturing has consistently increased its share, from 11% to 16% to over 23%.

The ADD's employment, as well as its growth, has represented about four to five percent of the Kentucky statewide totals.

Exhibit A-5.2t-Pennyrile A.D.D. Employment Trends, "At-Year" for 1950, 1960, and 1970

Employment Category	At Year Number			Per cent of A.D.D. total		
	1950	1960	1970	1950	1960	1970
Pennyrile A.D.D. Total	25,662	29,698	41,965	100%	100%	100%
Manufacturing Total	2,890	4,623	9,838	11.3	15.6	23.44
Food & kindred	511	532	487	2.0	1.8	1.16
Tobacco	49	98	105	.2	.3	.25
Clothing, textile, leather	1,364	1,903	3,253	5.3	6.4	7.75
Lumber & furniture	731	954	927	2.8	3.2	2.21
Print., publish., paper	108	254	301	.4	.9	.72
Chem., petrol., coal, rubber	17	53	704	.1	.2	1.68
Stone, clay, glass	87	125	83	.3	.4	.20
Primary metals	0	20	599	-	.1	1.43
Machinery, metal prod, equip.	11	672	3,225	.04	2.3	7.68
Other	12	12	154	.04	.04	.37
Non-Manufacturing Total	22,772	25,075	32,127	88.7	84.4	76.56
Mining & quarrying	6,893	5,172	4,804	26.9	17.4	11.45
Construction	568	1,570	1,776	2.2	5.3	4.23
Trans. comm., util, & R.R.	2,423	2,382	2,417	9.4	8.0	5.76
Wholesale-retail trade	6,434	6,195	7,584	25.1	20.9	18.07
Finance. insur., & real est.	456	835	1,429	1.8	2.8	3.41
Services	1,590	2,646	4,973	6.2	8.9	11.85
Government	4,408	6,275	9,144	17.2	21.1	21.79

Exhibit A-5.3t-Pennyrile A.D.D. Employment Trends "Between-Year" Changes, 1950-1970

Employment Category	Kentucky number Change		Pennyrile ADD no. Changes		ADD % Change		ADD % of KY. Change	
	1950-60	1960-70	1950-60	1960-70	1950-60	1960-70	1950-60	1960-70
Total Non-Ag. Employment	74,396	283,307	4,036	12,267	16%	41%	5.43%	4.33%
Manufacturing total	32,724	81,704	1,733	5,215	60%	113%	5.30%	6.38%
Food & kindred	192	-1.361	21	-45	4	-8	10.94	(*)
Tobacco	2,191	2,279	49	7	1	7	2.24	0.31
Clothing, textile,leather	3,035	12,114	539	1,350	40	71	17.76	11.14
Lumber & furniture	-2,527	1,009	223	-27	31	-3	(*)	(*)
Print, publish., paper	2,962	7,338	146	47	135	18	4.93	0.64
Chem.,petrol,coal,rub.	5,698	8,696	36	651	212	1228	0.63	7.49
Stone, clay, glass	1,307	1,212	38	-42	44	-34	2.91	(*)
Primary metals	194	5,454	20	579	0	2895	10.31	10.62
Mach.,metal prod. & equip	20,738	40,976	661	2,553	6009	380	3.19	6.23
Other	-1,066	3,986	0	142	0	1183	0	3.56
Non-Manufacturing total	41,662	201,613	2,303	7,052	10%	28%	5.53	3.50
Mining & quarrying	28,253	4,627	-1,721	-368	-25	-7	(*)	(*)
Construction	9,108	13,510	1,002	206	176	13	11.00	1.52
Trans.,comm.,util,&R.R.	7,640	5,272	-41	35	-2	1	(*)	0.66
Wholesale-retail trade	9,462	51,567	-239	1,389	-4	22	(*)	2.69
Fin.,insur., & real est.	6,970	13,015	370	594	81	71	5.31	4.56
Services	23,785	54,518	1,056	2,327	66	88	4.44	4.27
Government	28,230	68,358	1,867	2,869	42	46	6.61	4.20

*ADD lost employment

Employment Projections

The Pennyrile employment projections are shown by Exhibit A-5.4t. These figures were taken, or derived, from two reports secured from Ron Morgan, of the Ky. Dept. of Commerce. One report contained 1980 and 1990 projections for the entire state and each of the fifteen A.D.D. districts. The second report pertained only to the A.D.D.s and translated their projections into a "percent of state growth" for 1970-80 and 1980-90.

For purposes of this study, the projections had to be changed to the years of 1975, 1980, and 1995. The method for achieving this transition is described in the following by reference to Exhibit A-5.4t.

The exhibit figures were developed by moving from right to left --- that is, from columns #7 and #8 to columns #5 and #6, and, finally, to columns #2, #3, and #4.

Columns #7 and #8 projects the employment changes for the Pennyrile ADD in terms of its percentage share of the Ky. Statewide changes, by category. All of these percentage figures (except for the manufacturing sub-categories) were taken from the Kentucky Department of Commerce report. The reports percentage figures for 1970-80 were used in column #7 (for 1975-80 changes) and the 1980-90 figures were used for column #8 (for the 1980-95 period).

Since manufacturing sub-catagories were not included in the Dept. of Commerce projections, it was decided that similar figures for 1960-70 would be computed, and then used as much as possible in columns #7 and #8. The only places where the 1960-70 figures were not used pertained to 1960-70 decreases. Since it was decided that no decreases would be projected, the pertinent subcategories were stabilized at the 1970 level, and are shown in columns #7 and #8 as zeroes.

Columns #5 and #6 were filled in by applying the percentage figures (of #7 and #8) to the Statewide number changes shown by columns #5 and #6 of Exhibit A-5.1t. As one would expect, the resulting sub-category figures did not add up to the totals secured for "manufacturing" and for "non-manufacturing". In such cases, the difference was proportionately distributed among the sub-categories to force them to fit the totals. For 1975-80, "mfg" was increased by 522, from 4,656 to 5,178; and "non-mfg" was increased from 11,031 to 11,288.

Column #3 was developed by using the Ky. Dept. of Commerce figures for 1980. To secure the missing mfg. subcategories, the figure in column #5 was doubled (assuring same growth for 1970-75 as for 1975-80) and added to the 1970 employment. Column #2 was developed by subtracting column #5 from column #3. Column #4 (1995) was obtained by adding column #6 to Column #3.

As previously noted, the resulting "at year" figures did not always add up, and any differences were proportionately distributed. Thus, for 1975, "mfg" was reduced by 124, from 14,015 to 13,891; and "non-mfg" was increased from 36,986 to 37,154. For 1980, "mfg" was reduced by 124, from 18,192 to 18,068. For 1995, "mfg" was reduced by 124, from 23,370 to 23,246.

Exhibit A-5.4t- Pennyrile A.D.D. Employment Projections for 1975, 1980, And 1995

	At year number			Number change		% of KY. change	
Employment Category	1975	1980	1995	1975-80	1980-95	1975-80	1980-95
(Column #1)	(#2)	(#3)	(#4)	(#5)	(#6)	(#7)	(#8)
Pennyrile A.D.D.	51,045	61,533	77,999	10,488	16,466	4.91	4.93
Manufacturing total	13,891	18,068	23,246	4,177	5,178	6.38	6.38
Food & kindred	487	487	487	0	0	-0-	-0-
Tobacco	114	123	140	10	17	0.31	0.31
Clothing,textile,leat.	4,403	5,623	6,728	1,205	1,105	11.14	11.14
Lumber & furniture	927	927	927	0	0	-0-	-0-
Printing,publish.paper	325	341	399	22	54	0.64	0.64
Chem.petrol,coal,rubber	1,149	1,599	2,228	455	689	7.49	7.49
Stone,clay,glass	83	83	83	0	0	-0-	-0-
Primary metals	969	1,345	2,028	378	683	10.62	10.62
Mach.,metal prod. & eq.	5,230	7,285	9,805	2,055	2,525	6.23	6.23
Other	204	255	361	52	105	3.56	3.56
Non-Mfg. total	37,154	43,465	54,753	6,311	11,288	4.26	4.46
Mining & quarrying	5,959	7,159	9,552	1,225	2,393	16.94	16.94
Construction	1,809	2,018	2,257	217	239	1.52	1.52
Trans,comm,util, R.R.	2,488	2,491	2,569	15	78	0.66	0.66
Wholesale-retail trade	8,875	9,470	10,674	635	1,204	2.69	2.69
Finance,insur,real est.	1,853	2,113	2,927	268	814	4.56	4.56
Services	5,414	8,012	11,731	2,623	3,719	4.28	4.28
Government	10,756	12,202	15,043	1,496	2,841	4.20	4.20

PENNYRILE A.D.D. COUNTIES: THEIR TRENDS AND PROJECTIONS

Trends In Total County Employment

For the past twenty years, the Pennyrile ADD counties with the highest employment totals, as shown by Exh.A-5.5t, have been Hopkins, Christian, and Muhlenberg Counties. At the other end of the scale, the counties with the lowest employment figures, have been Lyon and Livingston Counties.

Exh. A-5.5t -County Total Employment Trends, 1950-70

Pennyrile ADD Breakdown	1950 Employ.	1960 Employ.	1970 Employ.
Pennyrile ADD	25,662	29,698	41,965
Livingston	480	1,112	1,046
Crittenden	919	1,075	1,618
Lyon	543	428	692
Caldwell	1,994	2,176	3,948
Trigg	704	959	1,603
Christian	6,386	9,180	12,074
Todd	1,084	1,280	1,840
Muhlenberg	5,245	4,647	6,967
Hopkins	8,307	8,841	12,177

County Changes

In the last decade, the highest number change occurred in Hopkins, Christian, and Muhlenberg Counties, and the lowest in Lyon and Livingston Counties (see Exh A-5.6t)

Exh.A-5.6t - County Employment Changes, 1950-70

Pennyrile ADD Breakdown	Number change		% Change	
	1950-60	1960-70	1950-60	1960-70
Pennyrile ADD	4,036	12,267	16%	41%
Livingston	632	-66	132	-6
Crittenden	156	543	17	51
Lyon	-115	264	-21	62
Caldwell	182	1,772	9	81
Trigg	255	644	36	67
Christian	2,794	2,894	44	32
Todd	196	560	18	44
Muhlenberg	598	2,320	11	50
Hopkins	534	3,336	6	38

Percentagewise, however, the highest increases occurred in Caldwell, Trigg, and Lyon. Altho Lyon's absolute number increase of 264 employees was next to the lowest, this still represented a 62 per cent increase over its 1960 employment level.

County As Part of ADD Total

When each County's employment is figured as a percentage of the ADD total, two major trends are observed: (1) Hopkins and Muhlenberg experienced decreases in their share of the Pennyrile total, and (2) the major share of their decrease was picked up by Christian County, with all other counties (except Lyon) sharing in the remainder. This represents a trend towards a widespread distribution of employment throughout the counties from 1950 to 1970 (see Exh. A-5.7t)

Exh. A-5.7t - County Changes As Part of A.D.D.

Pennyrile ADD Breakdown	% of A.D.D. Total		
	1950	1960	1970
Pennyrile ADD	100%	100%	100%
Livingston	1.8	3.7	2.5
Crittenden	3.6	3.6	3.9
Lyon	2.1	1.4	1.7
Caldwell	7.8	7.3	9.4
Trigg	2.7	3.2	3.8
Christian	24.9	30.9	28.8
Todd	4.2	4.3	4.4
Muhlenberg	20.4	15.7	16.6
Hopkins	32.4	29.8	29.0

Employment Breakdown Within Counties

Manufacturing jobs have been on the increase in the Pennyrile since 1950, but they still represent less than one-fourth of the ADD's total employment (see Exh. A-5.2t)

Manufacturing and non-manufacturing employment and their subcategories, are shown for each county on Exhibit A-5.8t. Overall, these 1950-1970 trends show a decrease, or very small gains, for the manufacturing categories of food and kindred; tobacco; lumber and furniture; printing, publishing, and paper; and stone, clay, and glass. In non-manufacturing, a loss of 368 was experienced by all counties in mining and quarrying, and only a slight increase of 35 was shown for transportation, communication and utilities.

The largest manufacturing gains were in machinery and metal; clothing, textile, & leather; and, for non-manufacturing, in government, services, and wholesale-retail trade.

Exhibit A-5.8t-Non-Agricultural Employment Trends, 1950-1970, For The Pennyrile A.D.D. "Counties"

Employment Category	At year number			Number change		% change		% of ADD Total		
	1950	1960	1970	1950-60	1960-70	50-60	60-70	50	60	70
Livingston Co. Total	480	1,112	1,046	632	-66	132%	-6%	1.8%	3.74	2.49
Manufacturing total	5	2	25	- 3	23	-60	115%	0.02	0.01	0.06
Food & kindred	0	0	0	0	0	-	-	-	-	-
Tobacco	0	0	1	0	1	-	-	-	-	-
Clothing,text.leath.	0	0	0	0	0	-	-	-	-	-
Lumber & furniture	5	2	24	3	22	6%	11%	0.02	0.01	0.06
Print.,publish.,paper	0	0	0	0	0	-	-	-	-	-
Chem.,petrol,coal,rubber	0	0	0	0	0	-	-	-	-	-
Stone, clay,glass	0	0	0	0	0	-	-	-	-	-
Primary metals	0	0	0	0	0	-	-	-	-	-
Mach.,met.prod &equip.	0	0	0	0	0	-	-	-	-	-
Other	0	0	0	0	0	-	-	-	-	-
Non-Mfg. total	475	1,110	1,021	635	-89	134%	8%	1.85	3.74	2.43
Mining & quarrying	125	111	189	-14	78	-11	70	0.49	0.37	0.45
Construction	36	576	63	540	-513	1,500	-89	0.14	1.94	0.15
Trans,comm.util, & R.R.	16	43	74	27	31	169	72	0.06	0.14	0.18
Wholesale-retail trade	75	86	118	11	32	15	37	0.29	0.29	0.28
Finance, insur,real est.	12	17	79	5	62	42	365	0.05	0.06	0.19
Services	17	45	128	28	83	165	184	0.07	0.16	0.31
Government	194	232	370	38	138	20	59	0.76	0.78	0.88
Crittenden Co. Total	919	1,075	1,618	156	543	17%	51%	3.58	3.62	3.86
Manufacturing total	56	268	542	212	274	379%	102%	0.22	0.90	1.29
Food & kindred	6	3	0	3	-3	50	-1	0.02	0.01	0
Tobacco	0	0	0	0	0	-	-	-	-	-
Clothing,textile,leather	0	0	0	0	0	-	-	-	-	-
Lumber & furniture	5	77	0	72	-77	1440	-100	0.02	0.26	0
Print,publish,paper	10	132	171	122	39	1220	30	0.04	0.44	0.41
Chem.,petrol,coal,rubber	0	0	0	0	0	-	-	-	-	-
Stone,clay,glass	24	47	8	23	-39	96	-83	0.09	0.16	0.02
Primary metals	0	0	0	0	0	-	-	-	-	-
Mach.,metal, prod.	11	0	363	-11	363	-1	0	0.40	0	0.87
Other	0	9	0	9	-9	0	-1	0	0.03	0
Non-Mfg. total	863	807	1,076	-56	269	-6%	33%	3.36	2.72	2.56
Mining & quarrying	332	103	57	-229	-46	-69	-45	1.29	0.35	0.14
Construction	52	34	73	-18	39	-35	115	0.20	0.11	0.17
Trans,comm.util,R.R.	43	50	83	7	33	16	66	0.17	0.17	0.20
Wholesale-retail trade	196	240	288	44	48	22	20	0.76	0.81	0.69
Finance,insur,real est.	26	36	45	10	9	38	25	0.10	0.12	0.11
Services	24	72	123	48	51	200	71	0.10	0.24	0.29
Government	190	272	407	82	135	43	50	0.74	0.92	0.97
Lyon County total	543	428	692	-115	264	-21%	62%	2.12	1.44	1.65
Manufacturing total	154	63	142	-91	79	-59%	-125%	0.60	0.21	0.34
Food & kindred	0	0	0	0	0	-	-	-	-	-
Tobacco	0	0	0	0	0	-	-	-	-	-
Clothing,textile,leath.	129	0	0	-129	0	-1	0	0.50	-	-
Lumber & furniture	25	51	0	26	-51	104	-1	0.10	0.17	-
Printing,publish.paper	0	3	0	3	-3	0	-1	-	0.01	-
Chem,petrol,coal,rubber	0	5	136	5	131	0	262	-	0.02	0.32
Stone,clay,glass	0	4	6	4	2	0	50	-	0.01	0.01
Primary metals	0	0	0	0	0	-	-	-	-	-
Mach,metal prod. & eqp.	0	0	0	0	0	-	-	-	-	-
Other	0	0	0	0	0	-	-	-	-	-
Non-Mfg. total	389	365	550	-24	185	-6%	51%	1.52	1.23	1.31
Mining & quarrying	0	0	0	0	0	-	-	-	-	-
Construction	2	7	43	5	36	250	51	-	0.02	0.10
Trans,comm,util, & R.R.	36	15	8	-21	-7	-58	-47	0.14	0.05	0.02
Wholesale-retail trade	81	70	101	-11	31	-14	44	0.32	0.24	0.24
Finance,insur,real est.	10	11	25	1	14	10	13	0.04	0.04	0.06
Services	18	32	56	14	24	78	75	0.07	0.11	0.13
Government	242	230	317	-12	87	-5	38	0.94	0.77	0.76

(continuation)

Exhibit A-5.8t-Non-Agricultural Employment Trends, 1950-1970, For The Pennyrile A.D.D. Counties

Employment Category	At year number			Number change		% change		% of ADD Total		
	1950	1960	1970	1950-60	1960-70	50-60	60-70	50	60	70
Caldwell Co. Total	1,994	2,176	3,948	182	1,772	9%	81%	7.77	7.33	9.41
Manufacturing total	558	567	1,603	9	1,036	2	183	2.17	1.91	3.82
Food & kindred	57	51	14	-6	-37	-11	-73	0.22	0.17	0.03
Tobacco	0	0	0	0	0	-	-	-	-	-
Clothing,textile,leath.	438	448	394	10	-54	2	-12	1.71	1.51	0.75
Lumber & furniture	42	47	55	5	8	12	17	0.16	0.18	0.13
Print,publish,paper	14	12	11	-2	-1	-14	-8	0.05	0.04	0.03
Chem,petrol,coal,rubber	2	4	5	2	1	1	25	0.01	0.01	0.01
Stone,clay,glass	5	5	0	0	-5	0	-1	0.01	0.01	-
Primary metals	0	0	0	0	0	-	-	-	-	-
Mach,metal prod, & eqp.	0	0	1,124	0	1,124	-	-	-	-	2.68
Other	0	0	0	0	0	-	-	-	-	-
Non-Mfg. total	1,436	1,609	2,345	173	736	12%	46%	5.60	5.42	5.59
Mining & quarrying	62	69	97	7	28	11	41	0.24	0.23	0.23
Construction	50	55	161	5	106	10	193	0.19	0.19	0.38
Trans,comm,util, & R.R.	375	303	252	-72	-51	-19	-17	1.46	1.02	0.60
Wholesale-retail trade	394	407	605	13	198	3	49	1.54	1.37	1.44
Finance,insur, &real est	32	61	81	29	20	91	33	0.12	0.21	0.19
Services	158	211	396	53	185	34	88	0.62	0.71	0.94
Government	365	503	753	138	250	38	50	1.42	1.69	1.79
Trigg Co. Total	704	959	1,603	255	644	36%	67%	2.74	3.23	3.82
Manufacturing total	131	170	426	39	256	30	151	0.51	0.57	1.02
Food & kindred	15	13	12	-2	-1	-13	-8	0.06	0.04	0.03
Tobacco	0	0	0	0	0	0	0	-	-	-
Clothing,textile,leath.	35	48	165	13	117	37	244	0.14	0.16	0.39
Lumber & furniture	66	105	20	39	-85	59	-81	0.26	0.35	0.05
Print,publish,paper	3	4	2	1	-2	33	-50	0.01	0.01	-
Chem,petrol,coal,rubber	0	0	0	0	0	-	-	-	-	-
Stone,clay,glass	0	0	0	0	0	-	-	-	-	-
Primary metals	0	0	0	0	0	-	-	-	-	-
Mach,metal prod, & equip	0	0	227	0	227	-	-	-	-	0.54
Other	12	0	0	-12	0	-1	0	0.05	0	0
Non-Mfg. total	573	789	1,177	216	388	38%	49%	2.23	2.66	2.80
Mining & quarrying	23	0	0	-23	0	-1	0	0.09	-	-
Construction	21	24	103	3	79	14	329	0.08	0.08	0.25
Trans,comm,util, & R.R.	72	51	44	21	-7	29	-14	0.28	0.17	0.10
Wholesale-retail trade	134	194	237	60	43	45	22	0.52	0.65	0.56
Finance,insur,real est.	15	20	32	5	12	33	60	0.06	0.07	0.08
Services	41	101	212	60	111	146	110	0.16	0.34	0.51
Government	267	399	549	132	150	49	38	1.04	1.34	1.31
Christian Co. total	6,386	9,180	12,074	2,794	2,894	44%	32%	24.89	30.91	28.77
Manufacturing total	1,116	2,184	3,452	1,068	1,268	96%	58%	4.35	7.35	8.23
Food & kindred	318	338	146	20	-192	6	-57	1.24	1.14	0.35
Tobacco	18	69	80	51	11	283	16	0.07	0.23	0.19
Clothing,textile,leath	550	818	1,145	268	327	49	40	2.14	2.75	2.73
Lumber & furniture	162	173	97	11	-76	7	44	0.63	0.58	0.23
Printing,publish,paper	30	43	59	13	16	43	37	0.12	0.14	0.14
Chem,petrol,coal,rubber	12	38	134	26	96	217	253	0.05	0.13	0.32
Stone, clay,glass	26	56	61	30	5	115	9	0.10	0.19	0.15
Primary metals	0	0	490	0	490	0	0	-	-	1.17
Mach,metal prod, & equip	0	649	1,093	649	444	0	68	-	2.19	2.60
Other	0	0	147	0	147	0	0	-	-	0.35
Non-Mfg. total	5,270	6,996	8,622	1,726	1,626	33%	23%	20.54	20.56	20.55
Mining & quarrying	100	87	128	-13	41	-13	47	0.40	0.29	0.31
Construction	247	419	454	172	35	70	8	0.96	1.41	1.08
Trans,comm,util,R.R.	560	593	625	33	32	6	5	2.18	1.99	1.49
Wholesale-retail trade	2,277	2,442	2,724	165	282	7	12	8.87	8.22	6.49
Finance,insur,real est.	200	445	616	245	171	123	38	0.78	1.50	1.47
Services	568	1,019	1,424	451	405	79	40	2.21	3.43	3.39
Government	1,318	1,991	2,651	673	660	51	33	5.14	6.70	6.32

(continuation)

Exhibit A-5.8t-Non-Agricultural Employment Trends, 1950-1970, For The Pennyrile A.D.D. Counties

Employment Category	At year number			Number change		% change		% of ADD Total		
	1950	1960	1970	1950-60	1960-70	50-60	60-70	1950	1960	1970
Todd Co. total	1,084	1,280	1,840	196	560	18%	44%	4.22	4.31	4.38
Manufacturing total	275	347	633	72	286	26	82	1.07	1.17	1.51
Food & kindred	6	9	0	3	-9	50	1	0.02	0.03	0
Tobacco	0	0	0	0	0	-	-	-	-	-
Clothing, text,leath.	151	237	299	86	62	57	26	0.59	0.80	0.71
Lumber & furniture	112	101	126	-11	25	-10	25	0.44	0.34	0.30
Print,publish,paper	2	0	0	2	0	1	0	-	-	-
Chem,petrol,coal,rubber	0	0	4	0	4	0	0	-	-	0.01
Stone, clay, glass	4	0	0	4	0	1	0	0.01	-	-
Primary metals	0	0	60	0	60	0	-	-	-	0.14
Mach, metal prod & eqpt.	0	0	144	0	144	0	0	-	-	0.34
Other	0	0	0	0	0	-	-	-	-	-
Non-Mfg. total	809	933	1,207	124	274	15%	29%	3.15	3.14	2.88
Mining & quarrying	28	15	8	-13	-7	-46	-47	0.11	0.05	0.02
Construction	2	7	20	5	13	250	186	0.01	0.02	0.05
Trans,comm,util, & R.R.	154	69	81	-85	12	-55	17	0.60	0.23	0.19
Wholesale-retail trade	289	333	413	44	80	15	24	1.13	1.12	0.98
Finance, insur, & real	20	24	40	4	16	20	67	0.08	0.08	0.10
Services	41	54	108	13	54	32	100	0.16	0.18	0.26
Government	275	431	537	156	106	57	25	1.07	1.45	1.28
Muhlenberg Co. total	5,245	4,647	6,967	598	2,320	11	50	20.44	15.65	16.60
Manufacturing total	234	425	1,149	191	724	82	170	0.91	1.43	2.74
Food & kindred	41	39	28	-2	-11	-5	-28	0.16	0.13	0.07
Tobacco	31	27	23	-4	-4	-13	-15	0.12	0.09	0.05
Clothing,textile,leath.	0	0	589	0	589	-	-	-	-	1.40
Lumber & furniture	142	331	376	189	45	133	14	0.55	1.11	0.90
Print,publish,paper	6	18	8	12	-10	2	-56	0.02	0.06	0.02
Chem,petrol,coal,rubber	0	2	35	2	33	0	17	-	0.01	0.08
Stone, clay, glass	14	8	2	-6	-6	-43	-75	0.05	0.02	-
Primary metals	0	0	0	0	0	-	-	-	-	-
Mach,metal prod 7 equip.	0	0	88	0	88	0	0	0	0	0.21
Other	0	0	0	0	0	-	-	-	-	-
Non-Mfg. total	5,011	4,222	5,817	-789	1,595	-16%	38%	19.53	14.22	13.86
Mining & quarrying	2,294	1,540	1,915	-754	375	-33	24	8.94	5.19	4.56
Construction	71	74	117	3	43	4	58	0.28	0.25	0.28
Tran,comm,util, & R.R.	516	542	508	26	-34	5	-6	2.01	1.83	1.21
Wholesale-retail trade	1,362	914	1,173	-448	259	-33	28	5.31	3.08	2.80
Finance,insur,real est.	44	60	121	16	61	36	102	0.17	0.20	0.29
Services	181	335	611	154	276	85	82	0.71	1.13	1.46
Government	534	757	1,372	214	615	39	81	2.12	2.55	3.27
Hopkins Co. total	8,307	8,841	12,177	534	3,336	6%	38%	32.37	29.77	29.02
Manufacturing total	361	597	1,866	236	1,269	65	213	1.41	2.01	4.45
Food & kindred	68	79	287	11	208	16	263	0.26	0.27	0.68
Tobacco	0	2	1	2	-1	0	-50	-	0.01	-
Clothing,text,leath.	61	352	661	291	309	477	88	0.24	1.18	1.58
Lumber & furniture	172	67	229	-105	162	-61	242	0.67	0.23	0.55
Printing,publish,paper	43	42	50	-1	8	-2	19	0.17	0.14	0.12
Chem,petrol,coal,rubber	3	4	390	1	386	33	9650	0.01	0.01	0.93
Stone,clay,glass	14	5	6	-9	1	-64	20	0.05	0.02	0.01
Primary metals	0	20	49	20	29	0	145	-	0.07	0.12
Mach,metal prod &eqpt.	0	23	186	23	163	0	709	-	0.08	0.44
Other	0	3	7	3	4	0	133	-	0.01	0.02
Non-Mfg. total	7,946	8,244	10,311	298	2,067	4%	25%	30.96	27.76	24.57
Mining & quarrying	3,929	3,247	2,410	-682	-837	-17	-26	15.31	10.93	5.74
Construction	87	374	742	287	368	330	98	0.34	1.26	1.77
Trans,comm,util, & R.R.	651	716	741	65	25	10	3	2.54	2.41	1.77
Wholesale-retail trade	1,626	1,509	1,925	-117	416	-7	28	6.34	5.08	4.59
Finance,insur,real est.	97	161	390	64	229	66	142	0.38	0.54	0.93
Services	542	777	1,915	235	1,138	43	146	2.11	2.62	4.56
Government	1,014	1,460	2,188	446	728	44	50	3.95	4.92	5.21

Employment Projections

Although past trend employment figures were available for each of the nine counties comprising the Pennyrile A.D.D., no projections have been made by the Ky. Department of Commerce.

Projection techniques were discussed with Ron Morgan of the Ky. Dept. of Commerce, and it was decided that the approaches, in order of preference, would be:

1st - Use the 1960-70 trend percentage figures showing the portion that each County represented of the ADD growth, by total, category, and subcategory. The 1960-70 percentage then would be used for 1975, 1980, and 1995 projections.

2nd - Use the 1970 percentage figures that show the portion that each County represented of the ADD total employment.

3rd - Where highly questionable projections result from the above approaches, try to apply common sense to modify.

Projecting By Short Range Trends

Exhibit A-5.9t uses the first approach, with a modification, to secure "percentages of the ADD change" that will be used for each Pennyrile County Under the "% of A.D.D. Change "columns, column #1 gives the actual 1960-70 figures. The decrease shown for Livingston County resulted from a loss of 513 construction jobs between 1960-70. Since all other non-mfg. categories showed increases, it would appear that 1975-1995 employment growth should occur in the county, as opposed to a continued decline. Without the construction loss, Livingston County would have had an increase representing about 3% increase for the future by proportionately reducing the figures for the other eight counties.

Exh. A-5.9t - Adjusted Pennyrile Change, 1960-70

Pennyrile ADD breakdown	1960-70 Employ Change	% of A.D.D. Change #1	#2	#3
Pennyrile ADD	12,267	100%	0%	100%
Livingston Co.	-66	-.55	3.55	3.00
Crittenden Co.	543	4.43	-.16	4.27
Lyon Co.	264	2.15	-.03	2.12
Caldwell Co.	1,772	14.45	-.60	13.85
Trigg Co.	644	5.25	-.20	5.05
Christian Co.	2,894	23.59	-.85	22.74
Todd Co.	560	4.57	-.17	4.40
Muhlenberg Co.	2,320	18.91	-.62	18.29
Hopkins Co.	3,336	27.20	-.92	26.28

When the percentages of column #3 (Exh. A-5.9t) are applied to the A.D.D. growth, the employment projections of Exhibit A-5.10t result for each of the Pennyrile Counties for 1975, 1980, and 1995.

Exhibit A-5.10t-Pennyrile Projections by Short Range Trends

Column #1	#2	#3	#4	#5
Pennyrile ADD Breakdown	% of ADD growth	1975 Emp. projection	1980 Emp. projection	1995 Emp. projection
Pennyrile ADD	100%	41,965 *1 9,080 *2 51,045 *3	51,045 *3 10,488 *4 61,533 *5	61,533 *5 16,466 *6 77,999 *7
Livingston County	3.00	1,046 272 1,318	1,318 315 1,633	1,633 494 2,127
Crittenden County	4.27	1,618 388 2,006	2,006 448 2,454	2,454 703 3,157
Lyon County	2.12	692 192 884	884 222 1,106	1,106 349 1,455
Caldwell County	13.85	3,948 1,258 5,206	5,206 1,453 6,659	6,659 2,280 8,939
Trigg County	5.05	1,603 459 2,062	2,062 530 2,592	2,592 832 3,424
Christian County	22.74	12,074 2,065 14,139	14,139 2,385 16,524	16,524 3,744 20,268
Todd County	4.40	1,840 399 2,239	2,239 461 2,700	2,700 725 3,425
Muhlenberg County	18.29	6,967 1,661 8,628	8,628 1,918 10,546	10,546 3,012 13,558
Hopkins County	26.28	12,177 2,386 14,563	14,563 2,756 17,319	17,319 4,327 21,646

*1-1970 employment *2- 1970-75 growth (for each county, this is based on the percentage of column #2 times the ADD's growth).
*3- 1975 projected total employment
*4- 1975-80 projected total employment
*5- 1980 projected total employment
*6- 1980-95 projected growth
*7- 1995 projected total employment

The approach of Exh. A-5.10t emphasizes the growth between 1960-70 as being the basis for projecting future growth. This, of course, assumes that recent trends will continue into 1995.

Projecting By Long-Range Trends

Another approach (#2) is to assume that long range trends will provide more acceptable projections than short range trends. This approach would rely on total employment as opposed to recent growth. Exhibit A-5.11t illustrates the employment projections resulting from this approach wherein each county's percentage of the total 1970 ADD employment is used as the basis for making 1975,1980, and 1995 projections.

Exh. A-5.11t- Pennyrile Projections By Long Range Trends

Column #1	#2	#3	#4	#5
Pennyrile ADD Breakdown	% of ADD Total	1975 Emp. Projection	1980 Emp. Projection	1995 Emp. Projection
Pennyrile ADD	100%	51,045	61,533	77,999
Livingston	2.49	1,271	1.532	1,942
Crittenden	3.86	1,970	2,375	3,011
Lyon Co.	1.65	842	1,015	1,287
Caldwell	9.41	4,803	5,790	7,340
Trigg Co.	3.82	1,950	2,351	2,980
Christian	28.77	14,686	17,703	22,440
Todd Co.	4.38	2,236	2,695	3,416
Muhlenberg	16.60	8,474	10,215	12,948
Hopkins	29.02	14,813	17,857	22,635

Comparing Projections

Exhibit A-5.12t compares the percentages used in the two approaches. When the total employment percentage is subtracted from the growth percentage, as shown in column #4, it becomes quickly apparent that seven of the nine counties would gain higher employment figures from the "growth" approach, while two would lose---Christian at 6% and Hopkins at almost 3%.

If one were to use the 1960-70 growth percentages for projecting employment, it would have to be based on the feeling that the growth rates for Christian and Hopkins Counties should be reduced in order to increase the rate for the remaining counties. The advisability of using this approach, however, is questionable in view of conflicting projections, or comments, made by other studies. The second approach (using percentage of ADD total growth) also would be in conflict with these other studies.

The Pennyrile ADD "Water and Sewer Facilities Study", for instance, describes the five primary future growth centers as being around Hopkinsville in Christian County, around Madisonville in Hopkins County, around Greenville and Central City in Muhlenberg County, around Princeton in Caldwell County, and around Lake Barkley in Lyon and Trigg Counties.

Exhibit A-5.12t-Comparison of Employment Percentages

Column #1	#2	#3	#4
Pennyrile ADD Breakdown	% of ADD 1960-70 Emp growth	% of ADD 1970 Total employ.	Growth % minus Total %
Pennyrile ADD	100%	100%	0
Livingston	3.00%	2.49%	.51%
Crittenden	4.27	3.86	.41
Lyon	2.12	1.65	.47
Caldwell Co.	13.85	9.41	4.44
Trigg Co.	5.05	3.82	1.23
Christian Co.	22.74	28.77	-6.03
Todd Co.	4.40	4.38	.02
Muhlenberg Co.	18.29	16.60	1.69
Hopkins Co.	26.28	29.02	-2.74

Population Projections

The K.P.D.O. and E.P.A. "Population Projection Studies" for Kentucky also appear to conflict, at least in part, with the employment percentages. Exhibit A-5.13t compare's the "population growth" and "total population" percentages, derived from the EPA projections. Although one would not expect that population and employment growth percentages

Exhibit A-5.13t-Comparison of Population Percentages

Column #1	#2	#3	#4
Pennyrile ADD breakdown	% of ADD 1980-95 pop. grow	% of ADD 1995 total population	Growth % minus total %
Pennyrile ADD	100%	100%	0
Livingston	3.21	4.08	-.87
Crittenden	4.01	4.65	-.64
Lyon	2.94	3.12	-.18
Caldwell	10.23	8.18	2.05
Trigg	2.00	4.06	-2.06
Christian	60.24	38.38	-21.86
Todd	1.60	4.96	-3.36
Muhlenberg	5.08	13.34	-8.26
Hopkins	10.69	19.22	-8.53

always would be equal or fairly close, one also would not expect the desparity that is shown for Christian County. Whereas this county is projected to receive over 60% of the 1980-95 ADD population growth, it would receive only 23% of the employment growth (see column #2 in Exh A-5.12t) if the 1960-1970 trends were extended into the future.

Selected Projection Method

It was decided that the method selected should be one that, for the present and near future, would primarily reflect the existing situation. Long range, however, the method should reflect Hopkinsville and Christian County as being the dominant future growth area in the Pennyrile A.D.D. This would basically agree with the future predictions of the Pennyrile A.D.D. "Water and Sewer Facilities Study" and the KPDO and EPA population projections.

This approach would mean that 1970 employment percentages could be used for 1975 projections; that 1980 projections should begin to reflect the growth importance of Hopkinsville and Christian County; and that 1995 employment figures should bring Christian County fairly close, percentagewise,

to their 1995 population figures. Also, it was decided that the Christian County increases in 1980 and 1995 would be derived completely from Hopkins and Muhlenberg Counties, while continuing to use, primarily, the 1970 figures for the other counties for 1975, 1980, and 1995 projections. For 1995, this would result in employment figures for Christian, Hopkins, and Muhlenberg Counties that would closely approximate the E.P.A. population projection percentages.

1975 Employment Projections

Exhibit A-5.14t shows the portion of the 1970 Pennyrile, A.D.D. employment by category that was located in each county. The percentage figures are added horizontally in order to achieve 100 per cent of the ADD total for each category.

As mentioned earlier, it was intended that the 1970 percentage figures be used to determine the 1975 distribution of employment for each county. This approach, however, was not completely successful, and certain minor modifications were necessary in some of the percentage figures. The lack of full success was due to problems such as the following:

-Employment stability was projected to occur between 1970-1975 in certain manufacturing categories (food and kindred lumber and furniture, and stone,clay, and glass), while growth was projected for others. This unbalanced the "manufacturing total percentage" for each county, as well as the county's "total employment percentage".

-Employment growth was projected to occur in one non-manufacturing category (mining and quarrying), but it was not to be distributed over all the counties. Rather, it was quite logically decided that it would go to those counties having the vital necessary resources available. These adjustments in mining and quarrying had a domino-effect on the "non-manufacturing totals" and the overall "employment total" for the counties.

The adjustments that had to be made in the projected 1975 percentage figures are shown by Exhibit A-5.15t. The resulting employment projections are shown by Exhibit A-5.16t.

1980 Employment Projections

The 1980 employment projections were not able to completely follow the 1970 employment percentages for the same reasons as mentioned in the previous paragraphs which dealt with the 1975 projections. In addition, it was decided that Christian County's share of the 1980 projection should be increased above its 1970 level in order to place it in closer conformance to population projections. As a result Christian's share of the total employment was increased 4.29 per cent (from 29.20 to 33.49), while Hopkins was decreased by 2.93 per cent (from 28.26 to 25.33) and Muhlenberg's was decreased by 1.71 per cent (from 16.18) to 14.47). This increase, or decrease, for each county was distributed throughout its employment subcategories in proportion to each sub-category's share of the county's total manufacturing or non-manufacturing growth. The percentage adjustments and employment projections are shown by Exhibits A-5.15t and A-5.16t.

1995 Employment Projections

The 1995 projections were subject to the same problems and remedies as mentioned in the previous paragraph for 1980 projections. As a result, Christian's share of the total employment was increased by 7.92 per cent (from 29.20 to 37.12), while Hopkins' was decreased by 5.62 per cent (from 28.26 to 22.64) and Muhlenberg's by 2.62 per cent (from 16.18 to 13.56). Also see Exhibits A-5.15t and A-5.16t.

Exhibit A-5.14t-1970 County Percentage of A.D.D. Employment, By Each Category

Employment Category	ADD Total	Livingston	Crittenden	Lyon	Caldwell	Trigg	Christian	Todd	Muhlenberg	Hopkins
Employment Total	100%	2.49%	3.86%	1.65%	9.41%	3.82%	28.77%	4.38%	16.60%	29.02%
Manufacturing Total	100	.25	5.51	1.44	16.29	4.33	35.10	6.43	11.68	18.97
Food & kindred	100	-	-	-	2.88	2.46	29.98	-	5.75	58.93
Tobacco	100	.95	-	-	-	-	76.19	-	21.91	.95
Clothing,text.lea.	100	-	-	-	12.11	5.07	35.20	9.19	18.10	20.32
Lumber,furn.	100	2.59	-	-	5.93	2.16	10.47	13.59	40.56	24.70
Print,pub.paper	100	-	56.81	-	3.66	.66	19.60	-	2.66	16.61
Chem,pet.coal,rub.	100	-	-	119.31	.71	-	19.03	.57	4.97	55.40
Stone,clay,glass	100	-	9.64	7.23	-	-	73.49	-	2.41	7.23
Primary metals	100	-	-	-	-	-	81.80	10.02	-	8.18
Mach,met.prod.eqp.	100	-	11.25	-	34.85	7.04	33.89	4.47	2.73	5.77
Other	100	-	-	-	-	-	95.45	-	-	4.55
Non-Mfg. total	100	.17	3.34	1.71	7.30	3.66	26.84	3.76	18.11	32.09
Mining & quarrying	100	3.93	1.19	-	2.02	-	2.66	.17	39.86	50.17
Construction	100	3.54	4.11	2.42	9.07	5.80	25.56	1.13	6.59	41.78
Trans,comm.util,RR	100	3.06	3.43	.33	10.43	1.82	25.86	3.35	21.02	30.66
Whsle,retail trade	100	1.56	3.80	1.33	7.98	3.12	35.92	5.44	15.47	25.38
Fin.,ins, real est	100	5.53	3.15	1.75	5.67	2.24	43.10	2.80	8.47	27.29
Services	100	2.57	2.47	1.13	7.96	4.26	28.64	2.17	12.29	38.51
Government	100	4.05	4.45	3.47	8.24	6.00	28.99	5.87	15.00	23.93

Exhibit A-5.15t - 1970, And Adjusted Projected Employment Percentages For 1970, 1980, & 1995

County / Employment categories	Livingston County					Crittenden County					Lyon County				
	1970	±	1975	1980	1995	1970	±	1975	1980	1995	1970	±	1975	1980	1995
Employment Total	2.5	-.1	2.4	2.3	2.3	3.9	+.09	4.0	4.0	4.0	1.7	+.04	1.7	1.7	1.7
Manufacturing total	.3	-.07	.2	.1	.1	5.5	-.11	5.6	5.7	5.8	1.4	+.20	1.6	1.7	1.9
Food & kindred	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tobacco	1.0	-	1.0	1.0	1.0	-	-	-	-	-	-	-	-	-	-
Cloth, text, leath.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lumber & furniture	2.6	-	2.6	2.6	2.6	-	-	-	-	-	-	-	-	-	-
Print.,pub., paper	-	-	-	-	-	56.8	-	56.8	56.8	56.8	-	-	-	-	-
Chem. pet,coal, rub	-	-	-	-	-	-	-	-	-	-	19.3	-	19.3	19.3	19.3
Stone, clay, glass	-	-	-	-	-	9.6	-	9.6	9.6	9.6	7.2	-	7.2	7.2	7.2
Primary metals	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mach, met. prod,	-	-	-	-	-	11.3	-	11.3	11.3	11.3	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Non-Mfg. Total	3.2	+.03	3.2	3.2	3.2	3.3	-.01	3.3	3.3	3.2	1.7	-	1.7	1.7	1.7
Mining & quarrying	3.9	-	3.9	3.9	3.9	1.2	-	1.2	1.2	1.2	-	-	-	-	-
Construction	3.5	-	3.5	3.5	3.5	4.1	-	4.1	4.1	4.1	2.4	-	2.4	2.4	2.4
Trans,comm,util,R.R.	3.1	-	3.1	3.1	3.1	3.4	-	3.4	3.4	3.4	.3	-	.3	.3	.3
Wholesale-retail trd	1.6	-	1.6	1.6	1.6	3.8	-	3.8	3.8	3.8	1.3	-	1.3	1.3	1.3
Fin,insur,real est.	5.5	-	5.5	5.5	5.5	3.2	-	3.2	3.2	3.2	1.8	-	1.8	1.8	1.8
Services	2.6	-	2.6	2.6	2.6	2.5	-	2.5	2.5	2.5	1.1	-	1.1	1.1	1.1
Government	4.1	-	4.1	4.1	4.1	4.5	-	4.5	4.5	4.5	3.5	-	3.5	3.5	3.5

	Caldwell County					Trigg County					Christian County				
Employment Total	9.4	+.62	10.0	10.4	10.5	3.8	+.04	3.9	3.9	3.9	28.8	+.43	29.2	33.5	37.1
Manufacturing total	16.3	+1.3	17.6	18.3	18.6	4.3	+.17	4.5	4.6	4.6	35.1	+.78	35.9	40.2	43.4
Food & kindred	2.9	-	2.9	2.9	2.9	2.5	-	2.5	2.5	2.5	30.0	-	30.0	30.0	30.0
Tobacco	-	-	-	-	-	-	-	-	-	-	76.2	-	76.2	76.2	76.2
Cloth, text, leath	12.1	-	12.1	12.1	12.1	5.1	-	5.1	5.1	5.1	35.2	-	35.2	41.9	44.4
Lumber & furn.	5.9	-	5.9	5.9	5.9	2.2	-	2.2	2.2	2.2	10.5	-	10.5	10.5	10.5
Print., pub, paper	3.7	-	3.7	3.7	3.7	.7	-	.7	.7	.7	19.6	-	19.6	19.7	21.6
Chem,pet,coal,rub.	.7	-	.7	.7	.7	-	-	-	-	-	19.0	-	19.0	31.0	41.1
Stone,clay,glass	-	-	-	-	-	-	-	-	-	-	73.5	-	73.5	73.5	73.5
Primary metals	-	-	-	-	-	-	-	-	-	-	81.8	-	81.8	83.5	85.1
Mach,met.prod,equi.	34.9	-	34.9	34.9	34.9	7.0	-	7.0	7.0	7.0	33.9	-	33.9	35.4	36.6
Other	-	-	-	-	-	-	-	-	-	-	95.5	-	95.5	95.5	95.5
Non-Mfg. total	7.3	-.1	7.2	7.2	7.1	3.7	-.04	3.6	3.6	3.6	26.8	-.14	26.7	30.7	34.5
Mining & quarrying	2.0	-	2.0	2.0	2.0	-	-	-	-	-	2.7	-	2.7	3.9	3.5
Construction	9.1	-	9.1	9.1	9.1	5.8	-	5.8	5.8	5.8	25.6	-	25.6	28.7	31.7
Trans,comm,util,R.R.	10.4	-	10.4	10.4	10.4	1.8	-	1.8	1.8	1.8	25.9	-	25.9	25.9	26.6
Whsle, retail trade	8.0	-	8.0	8.0	8.0	3.1	-	3.1	3.1	3.1	35.9	-	35.9	38.0	41.0
Fin,insur,real est.	5.7	-	5.7	5.7	5.7	2.2	-	2.2	2.2	2.2	43.1	-	43.1	45.6	52.7
Services	8.0	-	8.0	8.0	8.0	4.3	-	4.3	4.3	4.3	28.6	-	28.6	41.1	48.4
Government	8.2	-	8.2	8.2	8.2	6.0	-	6.0	6.0	6.0	29.0	-	29.0	32.7	36.9

	Todd County					Muhlenberg County					Hopkins County				
Employment total	4.4	+.06	4.4	4.4	4.3	16.6	-.42	16.2	14.5	13.6	29.0	-.76	28.3	25.3	22.6
Manufacturing total	6.4	-.17	6.3	6.2	6.0	11.7	-1.33	10.4	8.4	7.2	19.0	-.98	18.0	14.8	12.4
Food & Kindred	-	-	-	-	-	5.8	-	5.8	5.8	5.8	58.9	-	58.9	58.9	58.9
Tobacco	-	-	-	-	-	21.9	-	21.9	21.9	21.9	1.0	-	1.0	1.0	1.0
Cloth,text,leath	9.2	-	9.2	9.2	9.2	18.1	-	18.1	14.7	14.0	20.3	-	20.3	17.1	15.2
Lumber & furniture	13.6	-	13.6	13.6	13.6	40.6	-	40.6	40.6	40.6	24.7	-	24.7	24.7	24.7
Printing, pub,paper	-	-	-	-	-	2.7	-	2.7	2.7	2.7	16.6	-	16.6	16.6	14.5
Chem,pet,coal,rubber	.6	-	.6	.6	.6	5.0	-	5.0	5.0	3.9	55.4	-	55.4	43.6	34.4
Stone,clay,glass	-	-	-	-	-	2.4	-	2.4	2.4	2.4	7.2	-	7.2	7.2	7.2
Primary metals	10.0	-	10.0	10.0	10.0	-	-	-	-	-	8.2	-	8.2	6.5	4.9
Mach,met.prod,equip	4.5	-	4.5	4.5	4.5	2.7	-	2.7	2.4	2.0	5.8	-	5.8	4.6	3.8
Other	-	-	-	-	-	-	-	-	-	-	4.6	-	4.6	4.6	3.9
Non-Mfg. total	3.8	-	3.8	3.6	3.5	18.1	+.26	18.4	17.0	16.3	32.1	-	32.1	29.7	27.0
Mining & quarrying	.2	-	.2	.2	.2	39.9	-	39.9	39.9	39.9	50.2	-	50.2	50.2	50.2
Construction	1.1	-	1.1	1.1	1.1	6.6	-	6.6	6.6	6.6	41.8	-	41.8	38.6	35.7
Trans,comm,util,R.R.	3.4	-	3.4	3.4	3.4	21.0	-	21.0	21.0	21.0	30.7	-	30.7	30.7	29.9
Wholesale,ret.trade	5.4	-	5.4	5.4	5.4	15.5	-	15.5	14.6	13.7	25.4	-	25.4	24.2	22.1
Fin,insur,real est.	2.8	-	2.8	2.8	2.8	8.5	-	8.5	8.5	6.8	27.3	-	27.3	24.9	19.4
Services	2.2	-	2.2	2.2	2.2	12.3	-	12.3	9.1	8.2	38.5	-	38.5	29.3	22.9
Government	5.9	-	5.9	5.9	5.9	15.0	-	15.0	13.4	12.1	23.9	-	23.9	21.8	19.0

Exhibit A-5.16t-Projected Non-Agricultural Employment, 1975-1995 For The Pennyrile A.D.D. Counties

Employment Category	At year number			Number change		% change		% of ADD Categ.		
	1975	1980	1995	1975-80	1980-95	75-80	80-95	1975	1980	1995
Livingston Co. Total	1,215	1,418	1,798	203	380	16.71%	26.80%	2.38	2.30	2.31
Manufacturing total	25	25	25	0	0	0	0	0.18	.14	.11
Food & kindred	-	-	-	-	-	-	-	-	-	-
Clothing, textile, leather	-	-	-	-	-	-	-	-	-	-
Lumber & furniture	24	24	24	0	0	0	0	2.59	2.59	2.59
Print., publish, paper	-	-	-	-	-	-	-	-	-	-
Chem. petrol, coal, rubber	-	-	-	-	-	-	-	-	-	-
Stone, clay, glass	-	-	-	-	-	-	-	-	-	-
Primary metals	-	-	-	-	-	-	-	-	-	-
Mach., metal prod, equip.	-	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-	-
Non-Mfg. total	1,190	1,393	1,773	203	380	17.06	27.28	3.20	3.21	3.24
Mining & quarrying	234	291	375	47	94	20.09	33.45	3.93	3.93	3.93
Construction	64	71	80	7	9	10.94	12.68	3.54	3.54	3.54
Trans, comm, util, & R.R.	76	76	79	0	3	0	3.95	3.06	3.06	3.06
Wholesale-retail trade	138	148	167	10	19	7.24	12.84	1.56	1.56	1.56
Finance, insur., & real est	103	117	162	14	45	13.59	38.46	5.53	5.53	5.53
Services	139	206	301	67	95	48.20	46.12	2.57	2.57	2.57
Government	436	494	609	58	115	13.30	23.28	4.05	4.05	4.05
Crittenden Co. Total	2,018	2,443	3,090	425	647	21.06	26.48	3.95	3.97	3.96
Manufacturing total	780	1,022	1,338	242	316	31.03	30.92	5.62	5.65	5.76
Food & kindred	-	-	-	-	-	-	-	-	-	-
Tobacco	-	-	-	-	-	-	-	-	-	-
Clothing, textile, leath.	-	-	-	-	-	-	-	-	-	-
Lumber & furniture	-	-	-	-	-	-	-	-	-	-
Print, publish, paper	184	194	227	10	33	5.43	17.01	56.81	56.81	56.81
Chem., petrol, coal, rubber	-	-	-	-	-	-	-	-	-	-
Stone, clay, glass	8	8	8	0	0	0	0	9.64	9.64	9.64
Primary metals	-	-	-	-	-	-	-	-	-	-
Mach. metal prod, & equip.	588	820	1,103	232	283	39.45	34.51	11.25	11.25	11.25
Other	-	-	-	-	-	-	-	-	-	-
Non-Mfg. total	1,238	1,421	1,752	183	331	14.78	23.29	3.33	3.27	3.20
Mining & quarrying	71	85	114	14	29	19.72	34.12	1.19	1.19	1.19
Construction	74	83	93	9	10	12.16	12.04	4.11	4.11	4.11
Trans, comm., util, & R.R.	85	85	88	0	3	0	3.52	3.43	3.43	3.43
Wholesale-retail trade	337	360	406	23	46	6.82	12.78	3.80	3.80	3.80
Finance, insur, real est.	58	67	92	9	25	15.52	37.31	3.15	3.15	3.15
Services	134	198	290	64	92	47.76	46.46	2.47	2.47	2.47
Government	479	543	669	64	126	13.36	23.20	4.45	4.45	4.45
Lyon County Total	864	1,049	1,359	185	310	21.41	29.55	1.69	1.71	1.74
Manufacturing total	228	315	448	87	133	38.16	42.22	1.64	1.74	1.93
Food & kindred	-	-	-	-	-	-	-	-	-	-
Tobacco	-	-	-	-	-	-	-	-	-	-
Clothing, textile, leather	-	-	-	-	-	-	-	-	-	-
Lumber & furniture	-	-	-	-	-	-	-	-	-	-
Printing, publish. paper	-	-	-	-	-	-	-	-	-	-
Chem. petrol, coal, rubber	222	309	442	87	133	39.19	43.04	19.31	19.31	19.31
Stone, clay, glass	6	6	6	0	0	0	0	7.23	7.23	7.23
Primary metals	-	-	-	-	-	-	-	-	-	-
Mach., metal prod, eqpt.	-	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-	-
Non-Mfg. total	636	734	911	98	177	15.41	24.11	1.71	1.69	1.66
Mining & quarrying	-	-	-	-	-	-	-	-	-	-
Construction	44	49	55	5	6	11.36	12.24	2.41	2.42	2.42
Trans, comm, util, & R.R.	8	8	8	0	0	0	0	.33	.33	.33
Wholesale-retail trade	118	126	142	8	16	6.78	12.70	1.33	1.33	1.33
Finance, insur,real estate	32	37	51	5	14	15.62	37.84	1.75	1.75	1.75
Services	61	91	133	30	42	49.18	46.15	1.13	1.13	1.13
Government	373	423	522	50	99	13.40	23.40	3.47	3.47	3.47

(continuation)

Exhibit A-5.16c-Projected Non-Agricultural Employment, 1975-1995 For The Pennyrile A.D.D. Counties

Employment Category	At year number			Number change		% change		% of ADD Categ.		
	1975	1980	1995	1975-80	1980-95	75-80	80-95	1975	1980	1995
Caldwell Co. Total	5,119	6,420	8,190	1,301	1,770	25.42	27.57	10.03	10.43	10.50
Manufacturing total	2,445	3,313	4,332	868	1,019	35.50	30.76	17.60	18.34	18.63
Food & kindred	14	14	14	0	0	0	0	2.88	2.88	2.88
Tobacco	-	-	-	-	-	-	-	-	-	-
Clothing, textile, leather	533	681	815	148	134	27.77	19.68	12.11	12.11	12.11
Lumber & furniture	55	55	55	0	0	0	0	5.93	5.93	5.93
Print.,publish,paper	12	13	15	1	2	8.33	15.38	3.66	3.66	3.66
Chem, petrol, coal,rubber	8	11	16	3	5	37.50	45.45	.71	.71	.71
Stone, clay, glass	-	-	-	-	-	-	-	-	-	-
Primary metals	-	-	-	-	-	-	-	-	-	-
Machinery, metal prod & eqp	1,823	2,539	3,417	716	878	39.27	34.58	34.85	34.85	34.85
Other	-	-	-	-	-	-	-	-	-	-
Non-Mfg. total	2,674	3,107	3,858	433	751	16.19	24.17	7.20	7.15	7.05
Mining & quarrying	120	145	193	25	48	20.83	33.10	2.02	2.02	2.02
Construction	164	183	205	19	22	11.58	12.02	9.07	9.07	9.07
Trans, comm., util, R.R.	260	260	268	0	8	0	3.07	10.43	10.43	10.43
Wholesale-retail trade	708	756	852	48	96	6.77	12.70	7.98	7.98	7.98
Finance, insur., & real est	105	120	166	15	46	14.28	38.33	5.67	5.67	5.67
Services	431	638	934	207	296	48.02	46.39	7.96	7.96	7.96
Government	886	1,005	1,240	119	235	13.43	23.38	8.24	8.24	8.24
Trigg County Total	1,970	2,409	3,046	439	637	22.28	26.44	3.86	3.92	3.91
Manufacturing total	625	832	1,066	207	234	33.12	28.13	4.50	4.60	4.59
Food & kindred	12	12	12	0	0	0	0	2.46	2.46	2.46
Tobacco	-	-	-	-	-	-	-	-	-	-
Clothing, textile, leather	223	285	341	62	56	27.80	21.75	5.07	5.07	5.07
Lumber & furniture	20	20	20	0	0	0	0	2.16	2.16	2.16
Print., publish, paper	2	2	3	0	0	0	50.00	.66	.66	.66
Chem. petrol, coal, rubber	-	-	-	-	-	-	-	-	-	-
Stone, clay, glass	-	-	-	-	-	-	-	-	-	-
Primary metals	-	-	-	-	-	-	-	-	-	-
Mach. metal, prod & equip.	368	513	690	145	177	39.40	34.70	7.04	7.04	7.04
Other	-	-	-	-	-	-	-	-	-	-
Non-Mfg. total	1,345	1,577	1,980	232	403	17.25	25.55	3.62	3.63	3.62
Mining & quarrying	-	-	-	-	-	-	-	-	-	-
Construction	105	117	131	12	14	11.43	11.96	5.80	5.80	5.80
Trans, comm, util, & R.R.	45	45	47	0	2	0	4.44	1.82	1.82	1.82
Wholesale-retail trade	277	295	333	18	38	6.50	12.88	3.12	3.12	3.12
Finance, insur., real est	42	47	66	5	19	11.90	40.42	2.24	2.24	2.24
Services	231	341	500	10	59	4.33	17.30	4.26	4.26	4.26
Government	645	732	903	87	171	13.49	23.36	6.00	6.00	6.00
Christian Co. Total	14,904	20,610	28,951	5,706	8,341	38.29	40.47	29.20	33.49	37.12
Manufacturing total	4,984	7,258	10,085	2,274	2,827	45.63	38.95	35.88	40.17	43.38
Food & kindred	146	146	146	0	0	0	0	29.98	29.98	29.98
Tobacco	87	94	107	7	13	8.04	13.83	76.19	76.19	76.19
Clothing, textile, leath.	1,550	2,356	2,987	806	631	52.00	26.78	35.20	41.90	44.40
Lumber & furniture	97	97	97	0	0	0	0	10.47	10.47	10.47
Printing, publish, paper	64	67	86	3	19	4.69	28.36	19.60	19.65	21.55
Chem., petrol, coal, rubb	219	495	941	276	446	126.03	90.10	19.03	30.96	41.13
Stone, clay, glass	61	61	61	0	0	0	0	73.49	73.49	73.49
Primary metals	793	1,123	1,725	330	602	41.61	53.60	81.80	83.49	85.06
Machinery, metal prod,	1,772	2,567	3,588	804	1,012	45.37	39.28	33.89	35.36	36.59
Other	195	243	347	48	104	24.61	42.80	95.45	95.45	95.45
Non-Manufacturing total	9,920	13,352	18,866	3,432	5,514	34.60	41.30	26.70	30.72	34.46
Mining & quarrying	159	282	332	123	50	77.36	17.73	2.66	3.94	3.48
Construction	462	580	715	118	135	25.54	23.27	25.56	28.74	31.68
Trans, comm util, & R.R.	643	644	684	1	40	0.15	6.21	25.86	25.86	26.63
Wholesale-retail trade	3,188	3,598	4,371	410	773	12.86	21.48	35.92	37.99	40.95
Finance, insur, real est.	799	963	1,541	164	578	20.52	60.02	43.10	45.58	52.65
Services	1,551	3,291	5,674	1,740	2,383	112.85	72.41	28.64	41.08	48.37
Government	3,118	3,993	5,549	875	1,556	28.06	38.97	28.99	32.72	36.89

(continuation)

Exhibit A-5.16t-Projected Non-Agricultural Employment, 1975-1995 For The Pennyrile A.D.D. Counties

Employment Category	At year number			Number change		% change		% of ADD Categ.		
	1975	1980	1995	1975-80	1980-95	75-80	80-95	1975	1980	1995
Todd Co. Total	2,266	2,696	3,327	430	631	18.98%	23.41	4.44	4.38	4.27
Manufacturing total	869	1,714	1,398	245	284	28.19	25.49	6.26	6.16	6.01
Food & kindred	-	-	-	-	-	-	-	-	-	-
Tobacco	-	-	-	-	-	-	-	-	-	-
Clothing, textile, leather	405	517	618	112	101	27.65	19.53	9.19	9.19	9.19
Lumber & furniture	126	126	126	0	0	0	0	13.59	13.59	13.59
Print., publish., paper	-	-	-	-	-	-	-	-	-	-
Chem., pertrol, coal, rub	7	9	13	2	4	28.57	44.44	.57	.57	.57
Stone, clay, glass	-	-	-	-	-	-	-	-	-	-
Primary metals	97	136	203	39	67	40.20	49.26	10.02	10.02	10.02
Mach. metal prod. & equip.	234	326	438	92	112	39.31	34.35	4.47	4.47	4.47
Other	-	-	-	-	-	-	-	-	-	-
Non-Mfg. total	1,397	1,582	1,929	185	347	13.24	21.93	3.76	3.64	3.52
Mining & quarrying	10	12	16	2	4	20.00	33.33	.17	.17	.17
Construction	20	23	26	3	3	15.00	13.04	1.13	1.13	1.13
Trans, comm., util, & R.R.	83	83	86	0	3	0	3.61	3.35	3.35	3.35
Wholesale-retail trade	483	515	581	32	66	6.62	12.81	5.44	5.44	5.44
Finance, insur, & real est.	52	59	82	7	23	13.46	38.98	2.80	2.80	2.80
Services	118	174	255	56	81	47.46	46.55	2.17	2.17	2.17
Government	631	716	883	85	167	13.47	23.32	5.87	5.87	5.87
Muhlenberg Co. total	8,261	8,903	10,577	642	1,674	7.8	18.8	16.18	14.47	13.56
Manufacturing total	1,437	1,522	1,680	85	158	5.9	10.4	10.35	8.42	7.23
Food & kindred	28	28	28	0	0	0	0	5.75	5.75	5.75
Tobacco	25	27	31	2	4	8.00	14.81	21.91	21.91	21.91
Clothing, textile, leather	797	824	942	27	118	3.38	14.32	18.10	14.65	14.00
Lumber & furniture	376	376	376	0	0	0	0	40.56	40.56	40.56
Print., publish., paper	9	9	11	0	2	0	22.22	2.66	2.66	2.66
Chem., petrol, coal, rubber	57	77	89	20	12	35.08	15.58	4.97	4.97	3.89
Stone, clay, glass	2	2	2	0	0	0	0	2.41	2.41	2.41
Primary metals	-	-	-	-	-	-	-	-	-	-
Mach., metal, prod & equip.	143	179	201	36	22	25.17	12.29	2.73	2.46	2.05
Other	-	-	-	-	-	-	-	-	-	-
Non-Mfg. total	6,824	7,381	8,897	557	1,516	8.2	20.5	18.37	16.98	16.25
Mining & quarrying	2,375	2,806	3,769	431	963	18.15	34.32	39.86	39.86	39.86
Construction	119	133	149	14	16	11.76	12.03	6.58	6.58	6.58
Trans, comm, util, & R.R.	522	524	540	2	16	.38	3.05	20.98	20.98	20.98
Wholesale-retairl trade	1,373	1,380	1,462	7	82	.50	5.94	15.47	14.57	13.70
Finance, insur., real est.	157	179	200	22	21	14.01	11.73	8.47	8.47	6.83
Services	665	729	959	64	230	9.62	21.55	12.29	9.10	8.17
Government	1,613	1,630	1,818	17	188	1.05	11.53	15.00	13.36	12.09
Hopkins Co. total	14,426	15,584	17,661	1,158	2,077	8.0	13.3	28.26	25.33	22.64
Manufacturing total	2,499	2,669	2,874	170	205	6.8	7.7	17.99	14.77	12.36
Food & kindred	287	287	287	0	0	0	0	58.93	58.93	58.93
Tobacco	1	1	1	0	0	0	0	.95	.95	.95
Clothing, textile, leather	895	960	1,024	65	64	7.26	6.66	20.32	17.07	15.22
Lumber & furniture	229	229	229	0	0	0	0	24.70	24.70	24.70
Printing, publish, paper	54	57	58	0	1	5.55	1.75	16.61	16.61	14.54
Chem. petrol, coal, rubber	637	697	787	60	90	9.42	12.91	55.40	43.59	34.40
Stone, clay, glass	6	6	6	0	0	0	0	7.23	7.23	7.23
Primary metals	79	87	100	8	13	10.13	14.94	8.18	6.47	4.93
Mach., metal prod. & equip.	302	333	368	31	35	10.26	10.51	5.77	4.57	3.75
Other	9	12	14	3	1	33.33	8.33	4.55	4.55	3.88
Non-Mfg. total	11,927	12,915	14,787	988	1,872	8.3	14.5	32.09	29.71	27.01
Mining & quarrying	2,990	3,547	4,752	557	1,205	18.63	33.97	50.17	50.17	50.17
Construction	756	779	805	23	26	3.04	3.34	41.78	38.60	35.67
Trans, comm, util & R.R.	763	764	768	1	4	.13	.52	30.66	30.66	29.89
Wholesale-retail trade	2,253	2,291	2,357	38	66	1.69	2.88	25.38	24.19	22.08
Finance, insur, real est.	506	525	568	19	43	3.75	8.19	27.29	24.85	19.41
Services	2,085	2,345	2,687	260	342	12.47	14.58	38.51	29.27	22.91
Government	2,574	2,664	2,850	90	186	3.50	6.98	23.93	21.83	18.95

Locational Distribution of Projected Employment

The locational distribution of projected employment growth was reviewed with the Kentucky Department of Commerce, with special attention given to potential industrial sites in each County. The results for each County are presented in the remainder of this section.

Livingston County

All of the Livingston projected increase applies to non-manufacturing employment, mostly in the categories of government, services, mining-quarrying, and finance, insurance, and real estate (see Exh. A-5.17t) expected to share the major portion of this growth are Lake City-Grand Rivers, Ledbetter and Smithland.

Exh. A-5.17t-Livingston Co. Projected Employment

Employ. breakdown	No. & % change 1975-80	No. & % change 1980-95	% of ADD category 1975	% of ADD category 1980	% of ADD category 1995
Co. Total	203-17%	380-27%	2.38	2.30	2.31
Mfg.	0-0	0-0	0.18	0.14	0.11
Non-Mfg.	203-17%	380-27%	3.20	3.21	3.24

If manufacturing growth occurs in the future, it would possibly be along the Ohio and/or Tennessee Rivers, outside the L.C.R.B.

Exhibit A-5.18t shows the projected distribution by River Basin. All of the employment growth is estimated to occur south of the L.C.R.B., in Ledbetter, Lake City-Grand Rivers, and Smithland.

Exhibit A-5.18t-Distribution By River Basin

Non-mfg. category, and River basin	1975-80 Employ. Growth	1980-95 Employ. Growth
Livingston Co. tot.	203	380
Mining & quarry	47	94
-south of LCRB (L.C.)	(47)	(94)
Construction	7	9
-south of LCRB (led.)	(7)	(9)
Trans.,comm,etc.	0	3
-south of LCRB (Sm.)	(0)	(3)
Wholesale-Retail	10	19
-south of LCRB (led.)	(10)	(19)
Finance, insur., etc.	14	45
-south of LCRB (in Smith & led.)	(14)	(45)
Services	67	95
-south of LCRB (in Smith, led., L.C.)	(67)	(95)
Government	58	115
-South of LCRB (in Smith, led., L.C.)	(58)	(115)

Crittenden County

All of the Crittenden County projected employment growth is estimated to occur north of the L.C.R.B., in and around the City of Marion. Sites for development, especially for industry, primarily are located east of Marion, on Highways U.S. 60 and Ky. 20. The projected employment breakdown is shown by Exhibit A-5.16t.

Lyon County

Within Lyon County, the majority of any future development is estimated to occur in the Eddyville-Kuttawa area, and along the Lake Barkley shoreline.

All employment growth (see Exh.A-5.16t), however, is assigned to Segment Basin #6 (S.B. #6) of the L.C.R.B., which also contains most of the Eddyville-Kuttawa area.

Caldwell County

In Caldwell County it is estimated that all projected employment (Exh A-5.16t)growth will be located in Segment Basin #8, in the general vicinity of Princeton, Ky. Potential development areas include land:

-near the western city limits of Princeton and U.S. 62 and the Illinois Central Gulf Railroad

-in the vicinity of the Western Kentucky Parkway interchange with state highway Ky. 91

-east of Princeton, in the vicinity of Ky. 91, Ky. 128, and the Illinois Central Gulf' Railroad.

Trigg County

It is estimated that all projected employment growth for Trigg County (see Exh. A-5.16t) will occur in Segment Basin #10 of the L.C.R.B., the basin containing the City of Princeton.

Potential industrial development sites lie east of Cadiz, in the vicinity of U.S. 68 and the Cadiz Railroad. In addition to Cadiz locations, some commercial growth may be expected to develop strip fashion along U.S. 68 south of Cadiz.

Christian County

It is estimated that the majority of Christian County's future growth will be located in the Hopkinsville area, and along U.S. 41-A. The majority of the employment portion of this growth is expected to be concentrated in L.C.R.B. Segment Basin #14 , which includes the southeastern and eastern areas around Hopkinsville.

The only other significant employment growth areas are estimated to be Segment Basin #13 (north,west, and southwest areas around Hopkinsville);

and Segment Basin #11 of the L.C.R.B. which contains the interchange for I-24 and U.S. 41-A. The estimated distribution of projected employment for these three areas is shown by Exhibits A-5.19t and A-5.20t.

Exh. A-5.19t-Christian Co. Growth, 1975-80

Employment breakdown	Christian County total	Seg. Bas. #14	Seg. Bas. #13	Seg. Bas. #11
Total Emp. Growth	5,706	4,891	599	215
Mfg. total	2,274	2,148	126	-
tobacco	7	7	-	-
clothing,etc.	806	700	106	-
Printing, etc.	3	3	-	-
Chemical,etc.	276	276	-	-
Primary metals	330	330	-	-
Machinery, etc.	804	804	-	-
Other	48	28	20	-
Non-mfg. total	3,432	2,743	473	215
Mining, etc.	123	123	-	-
Construction	118	100	18	-
Trans, etc.	1	1	-	-
Wholesale-retail	410	328	41	41
Finance,etc.	164	150	14	-
Services	1,740	1,366	200	174
Government	875	675	200	-

Exh. A-5.20t-Christian Co. Growth, 1980-95

Employment breakdown	Christian County total	Seg. Basin #14	Seg. Basin #13	Seg. Basin #11
Total Emp. growth	8,341	6,996	1,021	315
Mfg. total	2,827	2,594	233	-
Tobacco	13	13	-	-
Clothing, etc.	631	431	200	-
Printing, etc.	19	10	9	-
Chemicals, etc.	446	446	-	-
Primary metals	602	602	-	-
Machinery, etc.	1,012	1,012	-	-
Other	104	80	24	
Non-mfg. total	5,514	4,402	788	315
Mining, etc.	50	50	-	-
Construction	135	110	25	-
Trans., etc.	40	40	-	-
Wholesale-retail	773	573	123	77
Finance, etc.	578	500	78	-
Services	2,383	1,883	262	238
Government	1,556	1,256	300	-

Todd County

It is estimated that Todd County's future employment growth will be located in or around the three cities of Elkton (S.B. #19), and Trenton and Guthrie (S.B. #18 of L.C.R.B.).

Elkton's industrial potential land is located west and southwest; Trentons is located east and southeast along Ky 848, the Louisviille & Nashville Railroad and U.S. 41; and Guthries is located to the northwest around U.S. 79 and the L & N Railroad.

The estimated destribution of employment growth within the two segment basins is shown by Exhibits A-5.21t and A-5.22t.

Exh. A-5.21t-Todd Co. Growth, 1975-80

Employment breakdown	Todd Co. total	Seg. Basin #19	Seg. Basin #18
Total Emp. growth	430	296	134
Mfg. total	245	162	83
Clothing, etc.	112	70	42
Chemical, etc.	2	2	-
Primary metals	39	30	9
Machinery, etc.	92	60	32
Non-mfg. total	185	134	51
Mining, etc.	2	2	-
Construction	3	3	-
Wholesale-retail	32	20	12
Finance, etc.	7	4	3
Services	56	30	26
Government	85	75	10

Exh. A-5.22t-Todd Co. Growth, 1980-95

Employment breakdown	Todd Co. total	Seg. Basin #19	Seg. Basin #18
Total Emp. growth	631	439	192
Mfg. total	284	204	80
Clothing, etc.	101	80	21
Chemicals, etc.	4	4	-
Primary metals	67	40	27
Machinery, etc.	112	80	32
Non-mfg. total	347	235	112
Mining, etc.	4	4	-
Construction	3	3	-
Trans, etc.	3	3	-
Wholesale-retail	66	40	26
Finance, etc.	23	15	8
Services	81	50	31
Government	167	120	47

Muhlenberg County

Muhlenberg County's future employment growth (Exh. A-5.16t) is estimated to occur primarily in the Greenville-Central City areas and the land between these two cities.

Hopkins County

It is estimated that future employment growth in Hopkins County (see Exh. A-5.16t) will be located primarily in and around the city of Madisonville, Ky.

LAND USE DISAGGREGATION

INTRODUCTION

The use that man makes of the land, whether for farming, residential, or other activities, contributes to the wastewater treatment load. Precise measurement of land use by detailed categories, however, was not a charge by the State for this study. Rather, the consultant was directed to extract the needed land use information from the various "Water and Sewerage" plans prepared for the Kentucky Area Development Districts (ADD's). Other planning data (for population, employment, housing, etc.) were to be gathered in a similar manner, leaving the more detailed and precise inventory for 201 and 208 studies, where more money and time would be available.

The land use categories to be inventoried and projected were:

-Rural
..Agriculture
..Silviculture
..Mining
..Construction
-Urban

USE OF A.D.D. DATA

Seven of the Lower Cumberland River Basin counties were in the Pennyrile A.D.D., while the remaining two counties were in the Barren River A.D.D. Neither of the "Water and Sewerage" plans for these A.D.D.'s, however, included any quantitative figures or any maps for "urban" or "construction" existing and future land uses, although they did contain some maps depicting the other rural land use categories.

This meant that the A.D.D. reports would be of little, if any, value in securing the needed generalized land use (or other planning) information for the Lower Cumberland River Basin.

USE OF SOIL CONSERVATION MAPS

Another possible source for the needed data was recent county "land use maps" prepared by the Soil Conservation Service of the U.S. Department of Agriculture, using county base maps from the Kentucky Department of Transportation. The Soil Conservation Service made these maps (no quantitative figures were included) available for the Lower Cumberland River Basin.

The maps were useable for quantifying (by planimeter) the rural categories of agriculture, silviculture, and mining-quarrying -- but, did not contain the type of information required for construction-related or urban land use.

In Christian County, for instance, these maps delineated approximately 35 square miles of urban-related land use as of 1975. This amount of land would accommodate 88,000 people (at 2,500 persons/sq. mile) to 227,000 people (at 6,500/sq. mile), although the presently accepted projection figure or estimate for 1975 is only 60,000 people for the entire county. Possibly the areas delineated as urban were intended to represent the potential areas within which any urban development might occur, as opposed to their exact delineation.

SELECTED METHOD FOR "URBAN-TYPE" LAND USE

After discounting the use of the ADD report or the Soil Conservation Maps to secure "urban-type" land use, it was decided that the following procedure would be used:

Step #1: Urban Places - For 1970, a figure of 5.56 persons per urban acre (or 3,560 per sq. mile) would be used, as reflected by the LCRB nine-county urban average, by Christian Co. "urban", and by the Bluegrass ADD "Water and Sewerage Plan" which projected growth ranges of from 2,500 to 6,500 persons per square mile for their 17 counties, with an average of ±3,500 persons/sq. mi.

Step #2: Rural Non-Farm Population - would be translated to urban-type acreage by dividing the non-farm population by the 3,560 persons/sq. mi.

Step #3: Total Urban - acreage, or square miles, would be the total urban-type land area derived from the above two steps.

Step #4: Construction-Related - land use will be assumed to equal the urban area expansion. As such, it will be shown only in the "between-years changes", and will not be an item for addition.

LAND USE DISAGGREGATION EXHIBITS

The two exhibits which follow in this appendix are:

Exh. A-6t - which provides land use figures by county; then subdivided into in-and-out of basin, and LCRB basin divided into segment basins.

Exh. A-6.1t - arranges above by segment basin.

Exhibit A-6t: County Land Use Disaggregation*1

Area Breakdown	"At-Year" Figures					"Between-Year" Changes		
	1970		1975	1980	1995	1970-75	1975-80	1980-95
	Acres	Sq. Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.
NINE-COUNTY TOTAL.....	2,374,400	3,710.00	3,710.00	3,710.00	3,710.00	0.00	0.00	0.00
..Outside LCRB.....	1,057,920	1,653.00	1,653.00	1,653.00	1,653.00	0.00	0.00	0.00
..Inside LCRB.....	1,316,480	2,057.00	2,057.00	2,057.00	2,057.00	0.00	0.00	0.00
..Rural.....	1,303,313	2,036.44	2,034.87	2,033.57	2,026.80	-1.57	-1.30	-6.77
..Agriculture.....	1,188,190	1,856.56	1,854.99	1,853.69	1,846.92	-1.57	-1.30	-6.77
..Silviculture.....	113,920	178.00	178.00	178.00	178.00	0.00	0.00	0.00
..Mining.....	1,203	1.88	1.88	1.88	1.88	0.00	0.00	0.00
..Construction*2....	-	-	-	-	-	(1.57)	(1.30)	(6.77)
..Urban-related*3.....	13,167	20.56	22.13	23.43	30.20	1.57	1.30	6.77
..(Urban Pop.)*4....	(73,207)	-	(78,778)	(83,402)	(107,485)	(5,575)	(4,624)	(24,083)
..(P/Ac/Sq.Mi.)*4...	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
LIVINGSTON COUNTY.....	218,880	342.00	342.00	342.00	342.00	0.00	0.00	0.00
..Outside LCRB.....	132,800	207.50	207.50	207.50	207.50	0.00	0.00	0.00
..Inside LCRB.....	86,080	134.50	134.50	134.50	134.50	0.00	0.00	0.00
..Rural.....	85,958	134.31	134.30	134.29	134.26	-.01	-.01	-.03
..Agriculture.....	81,491	127.31	127.30	127.29	127.26	-.01	-.01	-.03
..Silviculture.....	4,096	6.40	6.40	6.40	6.40	0.00	0.00	0.00
..Mining.....	371	.58	.58	.58	.58	0.00	0.00	0.00
..Construction.....	0	0	-	-	-	(.01)	(.01)	(.03)
..Urban-Related.....	122	.19	.20	.21	.24	0.01	0.01	0.03
..(Urban Pop.).....	(681)	-	(704)	(727)	(834)	(23)	(23)	(107)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#1 Segment Basin.....	48,064	75.10	75.10	75.10	75.10	0.00	0.00	0.00
..Rural.....	47,994	74.99	74.99	74.99	74.97	0.00	0.00	0.02
..Agriculture.....	46,669	72.92	72.92	72.92	72.90	0.00	0.00	0.02
..Silviculture.....	1,050	1.64	1.64	1.64	1.64	0.00	0.00	0.00
..Mining.....	275	.43	.43	.43	.43	0.00	0.00	0.00
..Construction.....	0	0	-	-	-	(0.00)	(0.00)	(0.02)
..Urban-Related.....	70	.11	.11	.11	.13	0.00	0.00	0.02
..(Urban Pop.)	(384)	-	(397)	(410)	(471)	(13)	(13)	(61)
..(P/Ac/Sq.Mi.).....	(5.56/ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#2 Segment Basin.....	22,528	35.20	35.20	35.20	35.20	0.00	0.00	0.00
..Rural.....	22,496	35.15	35.14	35.13	35.12	-.01	-.01	-.01
..Agriculture.....	20,973	32.77	32.76	32.75	32.74	-.01	-.01	-.01
..Silviculture.....	1,523	2.38	2.38	2.38	2.38	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	0	0	-	-	-	(.01)	(.01)	(.01)
..Urban-Related.....	32	.05	.06	.07	.08	.01	.01	.01
..(Urban Pop.).....	(175)	-	(200)	(225)	(253)	(25)	(25)	(28)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#4 Segment Basin.....	14,720	23.00	23.00	23.00	23.00	0.00	0.00	0.00
..Rural.....	14,701	22.97	22.97	22.97	22.96	0.00	0.00	-.01
..Agriculture.....	13,082	20.44	20.44	20.44	20.43	0.00	0.00	-.01
..Silviculture.....	1,523	2.38	2.38	2.38	2.38	0.00	0.00	0.00
..Mining.....	96	.15	.15	.15	.15	0.00	0.00	0.00
..Construction.....	0	0	-	-	-	(0.00)	(0.00)	(0.01)
..Urban-Related.....	19	.03	.03	.03	.04	0.00	0.00	0.01
..(Urban Pop.).....	(115)	-	(119)	(123)	(141)	(4)	(4)	(18)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-

*1-1970 land use figures were planimetered from one-of-a kind "land use maps" prepared by individual county agents of the Ky. Soil Conservation office. Acre and square mile figures include total surface area (land and water). Water area is included under "agriculture".

*2-Construction-related land use is assumed to be primarily that land which has been transformed from agricultural to urban use. Thus, no land use acreage is shown for construction for "at-year" periods; and the acreage shown for construction for "between year" periods simply reflects the newly urbanized land, and is not added into the rural acreage totals.

*3-Urban acreage reflects not only "urban areas" as defined by the U.S. Census, but also "rural non-farm areas shown to contain urban type development by the Soil Conservation Maps.

*4-These two "rows" do not read as acres or square miles; rather, the urban pop. row is the "total" of urban and rural non-farm population, and P/Ac/Sq.Mi. is the assumed number of persons per acre or per square mile (pop. density).

(continuation) Exhibit A-6t: County Land Use Disaggregation

Area Breakdown	"At-Year" Figures					"Between-Year" Change		
	1970		1975	1980	1995	1970-75	1975-80	1980-95
	Acres	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.
..#5 Segment Basin.....	768	1.20	1.20	1.20	1.20	0.00	0.00	0.00
..Rural.....	768	1.20	1.20	1.20	1.20	0.00	0.00	0.00
..Agriculture.....	768	1.20	1.20	1.20	1.20	0.00	0.00	0.00
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	(0)	(0)	-	-	-	(0.00)	(0.00)	(0.00)
..Urban-Related.....	0	0	0	0	0	0.00	0.00	0.00
..(Urban Pop.).....	(7)	-	(7)	(7)	(9)	(0)	(0)	(2)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
CRITTENDEN COUNTY.....	240,640	376.00	376.00	376.00	376.00	0.00	0.00	0.00
..Outside LCRB.....	185,728	290.20	290.20	290.20	290.20	0.00	0.00	0.00
..Inside LCRB.....	54,912	85.80	85.80	85.80	85.80	0.00	0.00	0.00
..Rural.....	54,752	85.55	85.55	85.54	85.51	0.00	-.01	-.03
..Agriculture.....	54,752	85.55	85.55	85.54	85.51	0.00	-.01	-.03
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	0	0	-	-	-	(0.00)	(0.01)	(0.03)
..Urban-Related.....	160	.25	.25	.26	.29	0.00	0.01	0.03
..(Urban Pop.).....	(882)	-	(901)	(917)	(1,018)	(19)	(16)	(101)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#1 Segment Basin....	29,568	46.20	46.20	46.20	46.20	0.00	0.00	0.00
..Rural.....	29,482	46.07	46.07	46.07	46.06	0.00	0.00	-.01
..Agriculture.....	29,482	46.07	46.07	46.07	46.06	0.00	0.00	-.01
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	0	0	0	0	0	(0.00)	(0.00)	(0.01)
..Urban-Related.....	86	.13	.13	.13	.14	0.00	0.00	0.01
..(Urban Pop.).....	(477)	-	(486)	(495)	(550)	(9)	(9)	(55)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#2 Segment Basin.....	2,045	3.20	3.20	3.20	3.20	0.00	0.00	0.00
..Rural.....	2,039	3.19	3.19	3.19	3.19	0.00	0.00	0.00
..Agriculture.....	2,039	3.19	3.19	3.19	3.19	0.00	0.00	0.00
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	0	0	-	-	-	(0.00)	(0.00)	(0.00)
..Urban-Related.....	6	.01	.01	.01	.01	0.00	0.00	0.00
..(Urban Pop.).....	(35)	-	(36)	(36)	(41)	(1)	(0)	(5)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#3 Segment Basin.....	23,296	36.40	36.40	36.40	36.40	0.00	0.00	0.00
..Rural.....	23,229	36.30	36.30	36.30	36.29	0.00	0.00	-.01
..Agriculture.....	23,229	36.30	36.30	36.30	36.29	0.00	0.00	-.01
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	0	0	-	-	-	(0.00)	(0.00)	(0.01)
..Urban-Related.....	67	.10	.10	.10	.11	0.00	0.00	0.01
..(Urban Pop.).....	(370)	-	(378)	(385)	(428)	(8)	(7)	(43)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
LYON COUNTY.....	168,320	263.00	263.00	263.00	263.00	0.00	0.00	0.00
..Outside LCRB.....	21,760	34.00	34.00	34.00	34.00	0.00	0.00	0.00
..Inside LCRB.....	146,560	229.00	229.00	229.00	229.00	0.00	0.00	0.00
..Rural.....	145,818	227.84	227.79	227.74	227.51	-.05	-.05	-.23
..Agriculture.....	119,770	187.14	187.09	187.04	186.81	-.05	-.05	-.23
..Silviculture.....	26,048	40.70	40.70	40.70	40.70	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	0	0	-	-	-	(.05)	(.05)	(.23)
..Urban-Related.....	742	1.16	1.21	1.26	1.49	.05	.05	.23
..(Urban Pop.).....	(4,116)	-	(4,278)	(4,440)	(5,254)	(162)	(162)	(814)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-

(continuation) Exhibit A-6t: County Land Use Disaggregation

Area Breakdown	"At-Year" Figures					"Between-Year" Changes		
	1970		1975	1980	1995	1970-75	1975-80	1980-95
	Acres	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.
..#3 Segment Basin.....	27,520	43.00	43.00	43.00	43.00	0.00	0.00	0.00
..Rural.....	27,260	42.59	42.58	42.56	42.48	-.01	-.02	-.05
..Agriculture.....	27,260	42.59	42.58	42.56	42.48	-.01	-.02	-.05
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	0	0	-	-	-	(.01)	(0.02)	(0.08)
..Urban-Related.....	260	.41	.42	.44	.52	0.01	0.02	0.08
..(Urban Pop.).....	(1,445)	-	(1,490)	(1,553)	(1,841)	(45)	(63)	(288)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#4 Segment Basin.....	12,800	20.00	20.00	20.00	20.00	0.00	0.00	0.00
..Rural.....	12,670	19.80	19.79	19.78	19.74	-.01	-.01	-.04
..Agriculture.....	12,670	19.80	19.79	19.78	19.74	-.01	-.01	-.04
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	0	0	0	0	0	(0.01)	(0.01)	(0.04)
..Urban-Related.....	130	.20	.21	.22	.26	0.01	0.01	0.04
..(Urban Pop.).....	(723)	-		(777)	(920)	(22)	(32)	(143)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#5 Segment Basin.....	88,320	138.00	138.00	138.00	138.00	0.00	0.00	0.00
..Rural.....	88,134	137.71	137.70	137.69	137.63	-.01	-.01	-.06
..Agriculture.....	62,086	97.01	97.00	96.99	96.93	-.01	-.01	-.06
..Silviculture.....	26,048	40.70	40.70	40.70	40.70	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	0	0	-	-	-	(0.01)	(0.01)	(0.06)
..Urban-Related.....	186	.29	.30	.31	.37	0.01	0.01	0.06
..(Urban Pop.).....	(1,045)	-	(1,111)	(1,140)	(1,343)	(66)	(29)	(203)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#6 Segment Basin.....	5,120	8.00	8.00	8.00	8.00	0.00	0.00	0.00
..Rural.....	5,072	7.92	7.92	7.92	7.90	0.00	0.00	-.02
..Agriculture.....	5,072	7.92	7.92	7.92	7.90	0.00	0.00	-.02
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	0	0	-	-	-	(0.00)	(0.00)	(0.02)
..Urban.....	48	.08	.08	.08	.10	0.00	0.00	0.02
..(Urban Pop.).....	(270)	-	(279)	(291)	(345)	(9)	(12)	(54)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#7 Segment Basin.....	3,840	6.00	6.00	6.00	6.00	0.00	0.00	0.00
..Rural.....	3,807	5.95	5.95	5.95	5.94	0.00	0.00	-.01
..Agriculture.....	3,807	5.95	5.95	5.95	5.94	0.00	0.00	-.01
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	0	0	-	-	-	0.00	0.00	0.01
..Urban-Related.....	33	.05	.05	.05	.06	0.00	0.00	0.01
..(Urban Pop.).....	(181)	-	(186)	(194)	(230)	(5)	(8)	(36)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#8 Segment Basin.....	8,960	14.00	14.00	14.00	14.00	0.00	0.00	0.00
..Rural.....	8,879	13.87	13.87	13.86	13.83	0.00	-.01	-.03
..Agriculture.....	8,879	13.87	13.87	13.86	13.83	0.00	-.01	-.03
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	0	0	-	-	-	(0.00)	(0.01)	(0.03)
..Urban-Related.....	81	.13	.13	.14	.17	0.00	0.01	0.03
..(Urban Pop.).....	(452)	-	(467)	(485)	(575)	(15)	(18)	(90)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-

(continuation) Exhibit A-6t: County Land Use Disaggregation

Area Breakdown	"At-Year" Figures					"Between-Year" Changes		
	1970		1975	1980	1995	1970-75	1975-80	1980-95
	Acres	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.
CALDWELL COUNTY.....	228,480	357.00	357.00	357.00	357.00	0.00	0.00	0.00
..Outside LCRB.....	127,104	198.60	198.60	198.60	198.60	0.00	0.00	0.00
..Inside LCRB.....	101,376	158.40	158.40	158.40	158.40	0.00	0.00	0.00
..Rural.....	99,994	156.24	156.07	155.89	155.07	-.17	-.18	-.82
..Agriculture.....	97,223	151.91	151.74	151.56	150.74	-.17	-.18	-.82
..Silviculture.....	2,675	4.18	4.18	4.18	4.18	0.00	0.00	0.00
..Mining.....	96	.15	.15	.15	.15	0.00	0.00	0.00
..Construction.....	0	0	-	-	-	(.17)	(.18)	(.82)
..Urban-Related.....	1,382	2.16	2.33	2.51	3.33	.17	.18	.82
..(Urban Pop.).....	(7,693)	-	(8,306)	(8,949)	(11,859)	(613)	(643)	(2,910)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#3 Segment Basin.....	14,080	22.00	22.00	22.00	22.00	0.00	0.00	0.00
..Rural.....	14,029	21.92	21.92	21.92	21.91	0.00	0.00	-.01
..Agriculture.....	12,813	20.02	20.02	20.02	20.01	0.00	0.00	-.01
..Silviculture.....	1,216	1.90	1.90	1.90	1.90	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	0	0	-	-	-	0.00	0.00	(.01)
..Urban-Related.....	51	.08	.24	.24	.25	0.00	0.00	0.01
..(Urban Pop.).....	(284)	-	(292)	(298)	(335)	(8)	(6)	(37)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#5 Segment Basin.....	14,976	23.40	23.40	23.40	23.40	0.00	0.00	0.00
..Rural.....	14,918	23.31	23.31	23.31	23.30	0.00	0.00	-.01
..Agriculture.....	14,278	22.31	22.31	27.31	22.30	0.00	0.00	-.01
..Silviculture.....	595	.93	.93	.93	.93	0.00	0.00	0.00
..Mining.....	45	.07	.07	.07	.07	0.00	0.00	0.00
..Construction.....	0	0	-	-	-	(0.00)	(0.00)	(0.01)
..Urban-Related.....	58	.09	.09	.09	.10	0.00	0.00	0.01
..(Urban Pop.).....	(304)	-	(313)	(320)	(359)	(9)	(7)	(39)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#8 Segment Basin.....	40,960	64.00	64.00	64.00	64.00	0.00	0.00	0.00
..Rural.....	39,795	62.18	62.02	61.85	61.08	-.16	-.17	-.77
..Agriculture.....	38,880	60.75	60.59	60.42	59.65	-.16	-.17	-.77
..Silviculture.....	864	1.35	1.35	1.35	1.35	0.00	0.00	0.00
..Mining.....	51	.08	.08	.08	.08	0.00	0.00	0.00
..Construction.....	0	0	-	-	-	(.16)	(.17)	(.77)
..Urban-Related.....	1,165	1.82	1.98	2.15	2.92	.16	.17	.77
..(Urban Pop.).....	(6,475)	-	(7,054)	(7,672)	(10,424)	(579)	(618)	(2,752)
..(P/Ac/Sq.Mi).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#9 Segment Basin.....	31,360	49.00	49.00	49.00	49.00	0.00	0.00	0.00
..Rural.....	31,232	48.80	48.79	48.79	48.77	-.01	0.00	-.02
..Agriculture.....	31,232	48.80	48.79	48.79	48.77	-.01	0.00	-.02
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	0	0	-	-	-	(.01)	(.00)	(.02)
..Urban-Related.....	128	.20	.21	.21	.23	0.01	0.00	0.02
..(Urban Pop.).....	(629)	-	(647)	(660)	(741)	(18)	(13)	(81)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
TRIGG COUNTY.....	299,520	468.00	468.00	468.00	468.00	0.00	0.00	0.00
..Outside LCRB.....	26,240	41.00	41.00	41.00	41.00	0.00	0.00	0.00
..Inside LCRB.....	273,280	427.00	427.00	427.00	427.00	0.00	0.00	0.00
..Rural.....	272,224	425.35	425.35	425.35	425.23	0.00	0.00	-.12
..Agriculture.....	190,624	297.85	297.85	297.85	297.73	0.00	0.00	-.12
..Silviculture.....	81,344	127.10	127.10	127.10	127.10	0.00	0.00	0.00
..Mining.....	256	.40	.40	.40	.40	0.00	0.00	0.00
..Construction.....	0	0	-	-	-	(0.00)	(0.00)	(.12)
..Urban-Related.....	1,056	1.65	1.65	1.65	1.77	0.00	0.00	0.12
..(Urban Pop.).....	(5,862)	-	(5,862)	(5,862)	(6,290)	(0)	(0)	(428)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-

(continuation) Exhibit A-6t: County Land Use Disaggregation

Area Breakdown	"At-Year Figures"					"Between-Year" Changes		
	1970		1975	1980	1995	1970-75	1975-80	1980-95
	Acres	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.
..#5 Segment Basin.....	122,880	192.00	192.00	192.00	192.00	0.00	0.00	0.00
..Rural.....	122,662	191.66	191.66	191.66	191.64	0.00	0.00	-.02
..Agriculture.....	43,750	68.36	68.36	68.36	68.34	0.00	0.00	-.02
..Silviculture.....	78,656	122.90	122.90	122.90	122.90	0.00	0.00	0.00
..Mining.....	256	.40	.40	.40	.40	0.00	0.00	0.00
..Construction.....	0	0	-	-	-	(0.00)	(0.00)	(0.02)
..Urban-Related.....	218	.34	.34	.34	.36	0.00	0.00	0.02
..(Urban Pop.).....	(1,206)	-	(1,206)	(1,206)	(1,262)	(0)	(0)	(56)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#8 Segment Basin.....	480	.75	.75	.75	.75	0.00	0.00	0.00
..Rural.....	465	.73	.73	.73	.73	0.00	0.00	0.00
..Agriculture.....	465	.73	.73	.73	.73	0.00	0.00	0.00
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	0	0	-	-	-	(0.00)	(0.00)	(0.00)
..Urban-Related.....	15	.02	.02	.02	.02	0.00	0.00	0.00
..(Urban Pop.).....	(83)	-	(83)	(83)	(90)	(0)	(0)	(7)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#9 Segment Basin.....	40,960	64.00	64.00	64.00	64.00	0.00	0.00	0.00
..Rural.....	40,750	63.67	63.67	63.67	63.64	0.00	0.00	-.03
..Agriculture.....	40,750	63.67	63.67	63.67	63.64	0.00	0.00	-.03
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	0	0	-	-	-	(0.00)	(0.00)	(0.03)
..Urban-Related.....	210	.33	.33	.33	.36	0.00	0.00	0.03
..(Urban Pop.).....	(1,165)	-	(1,165)	(1,165)	(1,257)	(0)	(0)	(92)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#10 Segment Basin....	107,040	167.25	167.25	167.25	167.25	0.00	0.00	0.00
..Rural.....	106,502	166.41	166.41	166.41	166.34	0.00	0.00	-.07
..Agriculture.....	103,814	162.21	162.21	162.21	162.14	0.00	0.00	-.07
..Silviculture.....	2,688	4.20	4.20	4.20	4.20	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	(0.00)	(0.00)	(0.07)
..Urban-Related.....	538	.84	.84	.84	.91	0.00	0.00	0.07
..(Urban Pop.).....	(2,992)	-	(2,992)	(2,992)	(3,232)	(0)	(0)	(240)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#11 Segment Basin....	1,920	3.00	3.00	3.00	3.00	0.00	0.00	0.00
..Rural.....	1,775	2.88	2.88	2.88	2.87	0.00	0.00	-.01
..Agriculture.....	1,775	2.88	2.88	2.88	2.87	0.00	0.00	-.01
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	0	0	-	-	-	(0.00)	(0.00)	(0.01)
..Urban-Related.....	75	.12	.12	.12	.13	0.00	0.00	0.01
..(Urban Pop.).....	(416)	-	(416)	(416)	(449)	(0)	(0)	(33)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
CHRISTIAN COUNTY.....	44,640	726.00	726.00	726.00	726.00	0.00	0.00	0.00
..Outside LCRB.....	166,400	260.00	260.00	260.00	260.00	0.00	0.00	0.00
..Inside LCRB.....	298,240	466.00	466.00	466.00	466.00	0.00	0.00	0.00
..Rural.....	290,240	453.50	452.24	451.26	446.20	-1.26	-0.98	-5.06
..Agriculture.....	289,856	452.91	451.64	450.66	445.60	-1.26	-0.98	-5.06
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	384	.60	.60	.60	.60	0.00	0.00	0.00
..Construction.....	0	0	-	-	-	(1.26)	(0.98)	(5.06)
..Urban-Related.....	8,000	12.50	13.76	14.74	19.80	1.26	0.98	5.06
..(Urban Pop.).....	(44,434)	-	(48,861)	(52,362)	(70,555)	(4,427)	(3,501)	(18,193)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-

(continuation) Exhibit A-6t: County Land Use Disaggregation

Area Breakdown	"At-Year" Figures					"Between-Year" Changes		
	1970		1975	1980	1995	1970-75	1975-80	1980-95
	Acres	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.
..#9 Segment Basin.....	19,968	31.20	31.20	31.20	31.20	0.00	0.00	0.00
..Rural.....	19,853	31.02	31.02	31.01	30.94	0.00	-0.01	-0.07
..Agriculture.....	19,853	31.02	31.02	31.01	30.94	0.00	-0.01	-0.07
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	-	-	0.00	0.00	0.00
..Construction.....	0	0	-	-	-	(0.00)	(0.01)	(0.07)
..Urban-Related.....	115	0.18	0.18	0.19	0.26	0.00	0.01	0.07
..(Urban Pop.).....	(641)	-	(636)	(682)	(918)	(-5)	(46)	(236)
..(P.Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#10 Segment Basin....	74,240	116.00	116.00	116.00	116.00	0.00	0.00	0.00
..Rural.....	73,814	115.33	115.33	115.28	115.03	0.00	-0.05	-0.25
..Agriculture.....	73,814	115.33	115.33	115.28	115.03	0.00	-0.05	-0.25
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	0	0	-	-	-	(0.00)	(0.05)	(0.25)
..Urban-Related.....	426	.67	.67	.72	.97	0.00	0.05	0.25
..(Urban Pop.).....	(2,373)	-	(2,355)	(2,523)	(3,401)	(-18)	(168)	(878)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#11 Segment Basin....	56,320	88.00	88.00	88.00	88.00	0.00	0.00	0.00
..Rural.....	55,996	87.49	87.49	87.45	87.26	0.00	-0.04	-0.19
..Agriculture.....	55,996	87.49	87.49	87.45	87.26	0.00	-0.04	-0.19
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	0	0	-	-	-	(0.00)	(0.04)	(0.19)
..Urban-Related.....	324	.51	.51	.55	.74	0.00	0.04	0.19
..(Urban Pop.).....	(1,799)	-	(1,785)	(1,913)	(2,577)	(-14)	(128)	(664)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#12 Segment Basin....	32,000	50.00	50.00	50.00	50.00	0.00	0.00	0.00
..Rural.....	31,816	49.71	49.71	49.69	49.58	0.00	-0.02	-0.11
..Agriculture.....	31,688	49.51	49.51	49.49	49.38	0.00	-0.02	-0.11
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	128	.20	.20	.20	.20	0.00	0.00	0.00
..Construction.....	120	0	-	-	-	(0.00)	(0.02)	(0.11)
..Urban-Related.....	184	.29	.29	.31	.42	0.00	0.02	0.11
..(Urban Pop.).....	(1,024)	-	(1,016)	(1,089)	(1,467)	(-8)	(73)	(378)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#13 Segment Basin....	38,400	60.00	60.00	60.00	60.00	0.00	0.00	0.00
..Rural.....	34,417	53.78	53.03	52.53	49.93	-0.75	-0.50	-2.60
..Agriculture.....	34,289	53.58	52.83	52.33	49.73	-0.75	-0.50	-2.60
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	128	.20	.20	.20	.20	0.00	0.00	0.00
..Construction.....	0	0	-	-	-	(0.75)	(0.50)	(2.60)
..Urban-Related.....	3,983	6.22	6.97	7.47	10.07	0.75	0.50	2.60
..(Urban Pop.).....	(22,145)	-	(24,834)	(26,614)	(35,861)	(2,685)	(1,780)	(9,247)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#14 Segment Basin....	42,240	66.00	66.00	66.00	66.00	0.00	0.00	0.00
..Rural.....	39,478	61.69	61.18	60.84	59.05	-0.51	-0.34	-1.79
..Agriculture.....	39,350	61.49	60.98	60.64	58.85	-0.51	-.034	-1.79
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	128	.20	.20	.20	.20	0.00	0.00	0.00
..Construction.....	0	0	-	-	-	(0.51)	(0.34)	(1.79)
..Urban-Related.....	2,762	4.31	4.82	5.16	6.95	0.51	0.34	1.79
..(Urban Pop.).....	(15,305)	-	(17,094)	(18,319)	(24,684)	(1,789)	(1,225)	(6,365)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-

(continuation) Exhibit A-6t: County Land Use Disaggregation

Area Breakdown	"At-Year" Figures					"Between-Year" Changes		
	1970		1975	1980	1995	1970-75	1975-80	1980-95
	Acres	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.
..#15 Segment Basin....	12,160	19.00	19.00	19.00	19.00	0.00	0.00	0.00
..Rural.....	12,089	18.89	18.89	18.88	18.84	0.00	-0.01	-0.04
..Agriculture.....	12,089	18.89	18.89	18.88	18.84	0.00	-0.01	-0.04
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.01)	(0.04)
..Urban-Related.....	71	.11	.11	.12	.16	0.00	0.01	0.04
..(Urban Pop.).....	(392)	-	(389)	(417)	(562)	(-3)	(28)	(145)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#16 Segment Basin....	19,968	31.20	31.20	31.20	31.20	0.00	0.00	0.00
..Rural.....	19,847	31.01	31.01	31.00	30.93	0.00	-0.01	-0.07
..Agriculture.....	19,847	31.01	31.01	31.00	30.93	0.00	-0.01	-0.07
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.01)	(0.07)
..Urban-Related.....	121	.19	.19	.20	.27	0.00	0.01	0.07
..(Urban Pop.).....	(670)	-	(665)	(713)	(960)	(-5)	(48)	(247)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#17 Segment Basin....	1,920	3.00	3.00	3.00	3.00	0.00	0.00	0.00
..Rural.....	1,910	2.98	2.98	2.98	2.97	0.00	0.00	-0.01
..Agriculture.....	1,910	2.98	2.98	2.98	2.97	0.00	0.00	-0.01
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.01)
..Urban-Related.....	10	.02	.02	.02	.03	0.00	0.00	0.01
..(Urban Pop.).....	(57)	-	(57)	(61)	(83)	(0)	(4)	(22)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#18 Segment Basin....	1,024	1.60	1.60	1.60	1.60	0.00	0.00	0.00
..Rural.....	1,019	1.59	1.59	1.59	1.59	0.00	0.00	0.00
..Agriculture.....	1,019	1.59	1.59	1.59	1.59	0.00	0.00	0.00
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	0.00	0.00	0.00
..Urban-Related.....	5	.01	.01	.01	.01	0.00	0.00	0.00
..(Urban Pop.).....	(29)	-	(29)	(31)	(41)	(0)	(2)	(10)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
TODD COUNTY.....	240,640	376.00	376.00	376.00	376.00	0.00	0.00	0.00
..Outside LCRB.....	84,096	131.40	131.40	131.40	131.40	0.00	0.00	0.00
..Inside LCRB.....	156,544	244.60	244.60	244.60	244.60	0.00	0.00	0.00
..Rural.....	155,699	243.28	243.28	243.28	243.22	0.00	0.00	-0.06
..Agriculture.....	155,699	243.28	243.28	243.28	243.22	0.00	0.00	-0.06
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.06)
..Urban-Related.....	845	1.32	1.32	1.32	1.38	0.00	0.00	0.06
..(Urban Pop.).....	(4,713)	-	(4,713)	(4,713)	(4,921)	(0)	(0)	(208)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#14 Segment Basin....	1,024	1.60	1.60	1.60	1.60	0.00	0.00	0.00
..Rural.....	1,018	1.59	1.59	1.59	1.59	0.00	0.00	0.00
..Agriculture.....	1,018	1.59	1.59	1.59	1.59	0.00	0.00	0.00
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	0.00	0.00	0.00
..Urban-Related.....	6	.01	.01	.01	.01	0.00	0.00	0.00
..(Urban Pop.).....	(29)	-	(29)	(29)	(30)	(0)	(0)	(1)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-

(continuation) Exhibit A-6t: County Land Use Disaggregation

Area Breakdown	"At-Year" Figures					"Between-Year" Changes		
	1970		1975	1980	1995	1970-75	1975-80	1980-95
	Acres	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.
..#15 Segment Basin....	512	.80	.80	.80	.80	0.00	0.00	0.00
..Rural.....	509	.80	.80	.80	.80	0.00	0.00	0.00
..Agriculture.....	509	.80	.80	.80	.80	0.00	0.00	0.00
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.00)
..Urban-Related.....	3	0	0	0	0	0.00	0.00	0.00
..(Urban Pop.).....	(15)	-	(15)	(15)	(15)	(0)	(0)	(0)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#16 Segment Basin....	512	.80	.80	.80	.80	0.00	0.00	0.00
..Rural.....	509	.80	.80	.80	.80	0.00	0.00	0.00
..Agriculture.....	509	.80	.80	.80	.80	0.00	0.00	0.00
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.00)
..Urban-Related.....	3	0	0	0	0	0.00	0.00	0.00
..(Urban Pop.).....	(15)	-	(15)	(15)	(15)	(0)	(0)	(1)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#17 Segment Basin....	46,560	72.75	72.75	72.75	72.75	0.00	0.00	0.00
..Rural.....	46,317	72.37	72.37	72.37	72.35	0.00	0.00	-0.02
..Agriculture.....	46,317	72.37	72.37	72.37	72.35	0.00	0.00	-0.02
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.02)
..Urban-Related.....	243	.38	.38	.38	.40	0.00	0.00	0.02
..(Urban Pop.).....	(1,363)	-	(1,363)	(1,363)	(1,426)	(0)	(0)	(63)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#18 Segment Basin....	30,368	47.45	47.45	47.45	47.45	0.00	0.00	0.00
..Rural.....	30,195	47.18	47.18	47.18	47.17	0.00	0.00	-0.01
..Agriculture.....	30,195	47.18	47.18	47.18	47.17	0.00	0.00	-0.01
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.01)
..Urban-Related.....	173	.27	.27	.27	.28	0.00	0.00	0.01
..(Urban Pop.).....	(957)	-	(957)	(957)	(996)	(0)	(0)	(39)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#19 Segment Basin....	52,480	82.00	82.00	82.00	82.00	0.00	0.00	0.00
..Rural.....	52,198	81.56	81.56	81.56	81.54	0.00	0.00	-0.02
..Agriculture.....	52,198	81.56	81.56	81.56	81.54	0.00	0.00	-0.02
..Silviculture.....	52,198	81.56	81.56	81.56	81.54	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.02)
..Urban-Related.....	282	.44	.44	.44	.46	0.00	0.00	0.02
..(Urban Pop.).....	(1,580)	-	(1,580)	(1,580)	(1,650)	(0)	(0)	(70)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#20 Segment Basin....	25,088	39.20	39.20	39.20	39.20	0.00	0.00	0.00
..Rural.....	24,954	38.90	38.99	38.99	38.98	0.00	0.00	-0.01
..Agriculture.....	24,954	38.99	38.99	38.99	38.98	0.00	0.00	-0.01
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.01)
..Urban-Related.....	134	.21	.21	.21	.22	0.00	0.00	0.01
..(Urban Pop.).....	(754)	-	(754)	(754)	(787)	(0)	(0)	(33)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-

(continuation) Exhibit A-6t: County Land Use Disaggregation

Area Breakdown	"At-Year" Figures					"Between-Year" Changes		
	1970		1975	1980	1995	1970-75	1975-80	1980-95
	Acres	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.
LOGAN COUNTY.....	360,320	563.00	563.00	563.00	563.00	0.00	0.00	0.00
..Outside LCRB.....	208,000	325.00	325.00	325.00	325.00	0.00	0.00	0.00
..Inside LCRB.....	152,320	238.00	238.00	238.00	238.00	0.00	0.00	0.00
..Rural.....	151,578	236.84	236.78	236.71	236.39	-0.06	-0.07	-0.32
..Agriculture.....	151,482	236.69	236.63	236.56	236.24	-0.06	-0.07	-0.32
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	96	.15	.15	.15	.15	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.06)	(0.07)	(0.32)
..Urban-Related.....	742	1.16	1.22	1.29	1.61	0.06	0.07	0.32
..(Urban Pop.).....	(4,125)	-	(4,353)	(4,590)	(5,714)	(228)	(237)	(1,124)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#19 Segment Basin....	15,360	24.00	24.00	24.00	24.00	0.00	0.00	0.00
..Rural.....	15,296	23.90	23.89	23.88	23.85	-0.01	-0.01	-0.03
..Agriculture.....	15,296	23.90	23.89	23.88	23.85	-0.01	-0.01	-0.03
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.01)	(0.01)	(0.03)
..Urban-Related.....	64	.10	.11	.12	.15	0.01	0.01	0.03
..(Urban Pop.).....	(351)	-	(380)	(401)	(499)	(29)	(21)	(98)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#20 Segment Basin....	135,040	211.00	211.00	211.00	211.00	0.00	0.00	0.00
..Rural.....	134,368	209.95	209.89	209.83	209.54	-0.06	-0.06	-0.29
..Agriculture.....	134,272	209.80	209.74	209.68	209.39	-0.06	-0.06	-0.29
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	96	.15	.15	.15	.15	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.06)	(0.06)	(0.29)
..Urban-Related.....	672	1.05	1.11	1.17	1.46	0.06	0.06	0.29
..(Urban Pop.).....	(3,728)	-	(3,925)	(4,137)	(5,151)	(197)	(212)	(1,014)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#21 Segment Basin....	1,920	3.00	3.00	3.00	3.00	0.00	0.00	0.00
..Rural.....	1,914	2.99	2.99	2.99	2.99	0.00	0.00	0.00
..Agriculture.....	1,914	2.99	2.99	2.99	2.99	0.00	0.00	0.00
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.00)
..Urban-Related.....	6	.01	.01	.01	.01	0.00	0.00	0.00
..(Urban Pop.).....	(45)	-	(49)	(52)	(64)	(4)	(3)	(12)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
SIMPSON COUNTY.....	152,960	239.00	239.00	239.00	239.00	0.00	0.00	0.00
..Outside LCRB.....	105,792	165.30	165.30	165.30	165.30	0.00	0.00	0.00
..Inside LCRB.....	47,168	73.70	73.70	73.70	73.70	0.00	0.00	0.00
..Rural.....	47,040	73.50	73.47	73.46	73.40	-0.03	-0.01	-0.06
..Agriculture.....	47,040	73.50	73.47	73.46	73.40	-0.03	-0.01	-0.06
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.03)	(0.01)	(0.06)
..Urban-Related.....	128	.20	.23	.24	.30	0.03	0.01	0.06
..(Urban Pop.).....	(701)	-	(800)	(842)	(1,040)	(99)	(42)	(198)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#20 Segment Basin....	46,656	72.90	72.90	72.90	72.90	0.00	0.00	0.00
..Rural.....	46,528	72.70	72.67	72.66	72.60	-0.03	-0.01	-0.06
..Agriculture.....	46,528	72.70	72.67	72.66	72.60	-0.03	-0.01	-0.06
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.03)	(0.01)	(0.06)
..Urban-Related.....	128	.20	.23	.24	.30	0.03	0.01	0.06
..(Urban Pop.).....	(693)	-	(792)	(833)	(1,028)	(99)	(41)	(195)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-

(continuation) Exhibit A-6t: County Land Use Disaggregation

Area Breakdown	"At-Year" Figures					"Between-Year" Changes		
	1970		1975	1980	1995	1970-75	1975-80	1980-95
	Acres	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.
..#22 Segment Basin....	512	.80	.80	.80	.80	0.00	0.00	0.00
..Rural.....	510	.80	.80	.80	.80	0.00	0.00	0.00
..Agriculture.....	510	.80	.80	.80	.80	0.00	0.00	0.00
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.00)
..Urban-Related.....	2	0	0	0	0	0.00	0.00	0.00
..(Urban Pop.).....	(8)	-	(9)	(9)	(12)	(1)	(0)	(3)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	-	-	-	(3,560)	(3,560)	(3,560)

Exhibit A-6.1t: Segment Land Use Projections

Area Breakdown	"At-Year" Figures					"Between-Year" Changes		
	1970		1975	1980	1995	1970-75	1975-80	1980-95
	Acres	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.
NINE-COUNTY TOTAL.....	2,374,400	3,710.00	3,710.00	3,710.00	3,710.00	0.00	0.00	0.00
..Outside LCRB.....	1,057,920	1,653.00	1,653.00	1,653.00	1,653.00	0.00	0.00	0.00
..Inside LCRB.....	1,316,480	2,057.00	2,057.00	2,057.00	2,057.00	0.00	0.00	0.00
..Rural.....	1,303,313	2,036.44	2,034.87	2,033.57	2,026.80	-1.57	-1.30	-6.77
..Agriculture.....	1,188,190	1,856.56	1,854.99	1,853.69	1,846.92	-1.57	-1.30	-6.77
..Silviculture.....	113,920	178.00	178.00	178.00	178.00	0.00	0.00	0.00
..Mining.....	1,203	1.88	1.88	1.88	1.88	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(1.57)	(1.30)	(6.77)
..Urban-related.....	13,167	20.56	22.13	23.43	30.20	1.57	1.30	6.77
..(Urban-Type Pop.).	(73,207)	-	(78,778)	-	(107,485)	(5,571)	(4,624)	(24,083)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#1 Segment Basin.....	77,632	121.30	121.30	121.30	121.30	0.00	0.00	0.00
..Rural.....	77,477	121.06	121.05	121.04	121.01	-0.00	-0.00	-0.03
..Agriculture.....	76,152	118.99	118.98	118.97	118.94	-0.01	-0.01	-0.03
..Silviculture.....	1,050	1.64	1.64	1.64	1.64	0.00	0.00	0.00
..Mining.....	275	.43	.43	.43	.43	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.01)	(0.01)	(0.03)
..Urban-Related.....	155	.24	.25	.26	.29	0.01	0.01	0.03
..(Urban-Type Pop.).	(861)	-	(883)	(905)	(1,021)	(22)	(22)	(126)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
LIVINGSTON COUNTY.....	48,064	75.10	75.10	75.10	75.10	0.00	0.00	0.00
..Rural.....	47,994	74.99	74.99	74.99	74.97	0.00	0.00	0.02
..Agriculture.....	46,669	72.92	72.92	72.92	72.90	0.00	0.00	0.02
..Silviculture.....	1,050	1.64	1.64	1.64	1.64	0.00	0.00	0.00
..Mining.....	275	.43	.43	.43	.43	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.02)
..Urban-Related.....	70	.11	.11	.11	.13	0.00	0.00	0.02
..(Urban-Type Pop.).	(384)	-	(397)	(410)	(471)	(13)	(13)	(61)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
CRITTENDEN COUNTY.....	29,568	46.20	46.20	46.20	46.20	0.00	0.00	0.00
..Rural.....	29,482	46.07	46.07	46.07	46.06	0.00	0.00	-0.01
..Agriculture.....	29,482	46.07	46.07	46.07	46.06	0.00	0.00	-0.01
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.01)
..Urban-Related.....	86	.13	.13	.13	.14	0.00	0.00	0.01
..(Urban-Type Pop.).	(477)	-	(486)	(495)	(550)	(9)	(9)	(55)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#2 Segment Basin.....	24,573	38.40	38.40	38.40	38.40	0.00	0.00	0.00
..Rural.....	24,535	38.34	38.33	38.32	38.31	-0.01	-0.01	-0.01
..Agriculture.....	23,012	35.96	35.95	35.94	35.93	-0.01	-0.01	-0.01
..Silviculture.....	1,523	2.38	2.38	2.38	2.38	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.01)	(0.01)	(0.01)
..Urban-Related.....	38	.06	.07	.08	.09	0.01	0.01	0.01
..(Urban-Type Pop.).	(210)	-	(236)	(261)	(294)	(26)	(25)	(33)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
LIVINGSTON COUNTY.....	22,528	35.20	35.20	35.20	35.20	0.00	0.00	0.00
..Rural.....	22,496	35.15	35.14	35.13	35.12	-.01	-.01	-.01
..Agriculture.....	20,973	32.77	32.76	32.75	32.74	-.01	-.01	-.01
..Silviculture.....	1,523	2.38	2.38	2.38	2.38	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.01)	(0.01)	(0.01)
..Urban-Related.....	32	.05	.06	.07	.08	0.01	0.01	0.01
..(Urban-Type Pop.).	(175)	-	(200)	(225)	(253)	(25)	(25)	(28)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-

(continuation) Exhibit A-6.1t: Segment Land Use Projections

Area Breakdown	"At-Year Figures" 1970 Acres	1970 Sq.Mi.	1975 Sq.Mi.	1980 Sq.Mi.	1995 Sq.Mi.	"Between-Year" Changes 1970-75 Sq.Mi.	1975-80 Sq.Mi.	1980-95 Sq.Mi.
CRITTENDEN COUNTY.....	2,045	3.20	3.20	3.20	3.20	0.00	0.00	0.00
..Rural.....	2,039	3.19	3.19	3.19	3.19	0.00	0.00	0.00
..Agriculture.....	2,039	3.19	3.19	3.19	3.19	0.00	0.00	0.00
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.00)
..Urban-Related.....	6	.01	.01	.01	.01	0.00	0.00	0.00
..(Urban-Type Pop.).	(35)	-	(36)	(36)	(41)	(1)	(0)	(5)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	0
..#3 Segment Basin.....	64,896	101.40	101.40	101.40	101.40	0.00	0.00	0.00
..Rural.....	64,518	100.81	100.79	100.77	100.67	-.02	-.02	-.10
..Agriculture.....	63,302	98.91	98.89	98.87	98.77	-.02	-.02	-.10
..Silviculture.....	1,216	1.90	1.90	1.90	1.90	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.02)	(0.02)	(0.10)
..Urban-Related.....	378	.59	.61	.63	.73	0.02	0.02	0.10
..(Urban-Type Pop.).	(2,099)	-	(2,160)	(2,236)	(2,604)	(161)	(76)	(368)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	(3,560)	(3,560)	(3,560)
CRITTENDEN COUNTY.....	23,296	36.40	36.40	36.40	36.40	0.00	0.00	0.00
..Rural.....	23,229	36.30	36.30	36.30	36.29	0.00	0.00	-.01
..Agriculture.....	23,229	36.30	36.30	36.30	36.29	0.00	0.00	-.01
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.01)
..Urban-Related.....	67	.10	.10	.10	.11	0.00	0.00	0.01
..(Urban-Type Pop.).	(370)	-	(378)	(385)	(428)	(68)	(67)	(43)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	-	-	-	-
CALDWELL COUNTY.....	14,080	22.00	22.00	22.00	22.00	0.00	0.00	0.00
..Rural.....	14,029	21.92	21.92	21.92	21.91	0.00	0.00	-.01
..Agriculture.....	12,813	20.02	20.02	20.02	20.01	0.00	0.00	-.01
..Silviculture.....	1,216	1.90	1.90	1.90	1.90	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	0.00	0.00	(0.01)
..Urban-Related.....	51	.08	.24	.24	.25	0.00	0.00	0.01
..(Urban-Type Pop.).	(284)	-	(292)	(298)	(335)	(8)	(6)	(37)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
LYON COUNTY.....	27,520	43.00	43.00	43.00	43.00	0.00	0.00	0.00
..Rural.....	27,260	42.59	42.58	42.56	42.48	-.01	-.02	-.08
..Agriculture.....	27,260	42.59	42.58	42.56	42.48	-.01	-.02	-.08
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.01)	(0.02)	(0.08)
..Urban-Related.....	260	.41	.42	.44	.52	0.01	0.02	0.08
..(Urban-Type Pop.).	(1,445)	-	(1,490)	(1,553)	(1,841)	(45)	(63)	(288)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#4 Segment Basin.....	27,520	43.00	43.00	43.00	43.00	0.00	0.00	0.00
..Rural.....	27,369	42.76	42.76	42.75	42.70	0.00	-.01	-.05
..Agriculture.....	25,750	40.23	40.23	40.22	40.17	0.00	-.01	-.05
..Silviculture.....	1,523	2.38	2.38	2.38	2.38	0.00	0.00	0.00
..Mining.....	96	.15	.15	.15	.15	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.01)	(0.05)
..Urban-Related.....	151	.24	.24	.25	.30	0.00	0.01	0.05
..(Urban-Type Pop.).	(838)	-	(864)	(900)	(1,061)	(26)	(36)	(161)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-

(continuation) Exhibit A-6.1t: Segment Land Use Projections

Area Breakdown	"At-Year" Figures					"Between-Year" Changes		
	1970		1975	1980	1995	1970-75	1975-80	1980-95
	Acres	Sq. Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.
LIVINGSTON COUNTY.....	14,720	23.00	23.00	23.00	23.00	0.00	0.00	0.00
..Rural.....	14,699	22.97	22.97	22.97	22.96	0.00	0.00	-.01
..Agriculture.....	13,080	20.44	20.44	20.44	20.43	0.00	0.00	-.01
..Silviculture.....	1,523	2.38	2.38	2.38	2.38	0.00	0.00	0.00
..Mining.....	96	.15	.15	.15	.15	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.01)
..Urban-Related.....	21	.03	.03	.03	.04	0.00	0.00	0.01
..(Urban-Type Pop.).	(115)	-	(119)	(123)	(141)	(4)	(4)	(18)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	(3,560)	(3,560)	(3,560)
LYON COUNTY.....	12,800	20.00	20.00	20.00	20.00	0.00	0.00	0.00
..Rural.....	12,670	19.80	19.79	19.78	19.74	-.01	-.01	-.04
..Agriculture.....	12,670	19.80	19.79	19.78	19.74	-.01	-.01	-.04
..Silviculture.....	0	0	0	0	0	0	0	0
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.01)	(0.01)	(0.04)
..Urban-Related.....	130	.20	.21	.22	.26	0.01	0.01	0.04
..(Urban-Type Pop.).	(723)	-	(745)	(777)	(920)	(22)	(32)	(143)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#5 Segment Basin.....	226,944	354.60	354.60	354.60	354.60	0.00	0.00	0.00
..Rural.....	226,482	353.88	353.87	353.86	353.77	-.01	-.01	-.09
..Agriculture.....	120,882	188.88	188.87	188.86	188.77	-.01	-.01	-.09
..Silviculture.....	105,299	164.53	164.53	164.53	164.53	0.00	0.00	0.00
..Mining.....	301	.47	.47	.47	.47	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.01)	(0.01)	(0.09)
..Urban-Related.....	462	.72	.73	.74	.83	0.01	0.01	0.09
..(Urban-Type Pop.).	(2,562)	-	(2,637)	(2,673)	(2,973)	(41)	(43)	(308)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
CALDWELL COUNTY.....	14,976	23.40	23.40	23.40	23.40	0.00	0.00	0.00
..Rural.....	14,918	23.31	23.31	23.31	23.30	0.00	0.00	-.01
..Agriculture.....	14,278	22.31	22.31	27.31	22.30	0.00	0.00	-.01
..Silviculture.....	595	.93	.93	.93	.93	0.00	0.00	0.00
..Mining.....	45	.07	.07	.07	.07	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.01)
..Urban-Related.....	58	.09	.09	.09	.10	0.00	0.00	0.01
..(Urban-Type Pop.).	(304)	-	(313)	(320)	(359)	(9)	(7)	(39)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
LYON COUNTY.....	88,320	138.00	138.00	138.00	138.00	0.00	0.00	0.00
..Rural.....	88,132	137.71	137.70	137.69	137.63	-.01	-.01	-.06
..Agriculture.....	62,084	97.01	97.00	96.99	96.93	-.01	-.01	-.06
..Silviculture.....	26,048	40.70	40.70	40.70	40.70	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.01)	(0.01)	(0.06)
..Urban-Related.....	188	.29	.30	.31	.37	0.01	0.01	0.06
..(Urban-Type Pop.).	(1,045)	-	(1,111)	(1,140)	(1,343)	(66)	(29)	(203)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
TRIGG COUNTY.....	122,880	192.00	192.00	192.00	192.00	0.00	0.00	0.00
..Rural.....	122,662	191.66	191.66	191.66	191.64	0.00	0.00	-.02
..Agriculture.....	43,750	68.36	68.36	68.36	68.34	0.00	0.00	-.02
..Silviculture.....	78,656	122.90	122.90	122.90	122.90	0.00	0.00	0.00
..Mining.....	256	.40	.40	.40	.40	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.02)
..Urban-Related.....	218	.34	.34	.34	.36	0.00	0.00	0.02
..(Urban-Type Pop.).	(1,206)	-	(1,206)	(1,206)	(1,262)	(0)	(0)	(56)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
LIVINGSTON COUNTY.....	768	1.20	1.20	1.20	1.20	0.00	0.00	0.00
..Rural.....	768	1.20	1.20	1.20	1.20	0.00	0.00	0.00
..Agriculture.....	768	1.20	1.20	1.20	1.20	0.00	0.00	0.00
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.00)
..Urban-Related.....	0	0	0	0	0	0.00	0.00	0.00
..(Urban-Type Pop.).	(7)	-	(7)	(7)	(9)	(0)	(0)	(2)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-

(continuation) Exhibit A-6.1t: Segment Land Use Projections

Area Breakdown	"At-Year" Figures					"Between-Year" Changes		
	1970		1975	1980	1995	1970-75	1975-80	1980-95
	Acres	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.
..#6 Segment Basin.....	5,120	8.00	8.00	8.00	8.00	0.00	0.00	0.00
LYON COUNTY.....	5,120	8.00	8.00	8.00	8.00	0.00	0.00	0.00
..Rural.....	5,072	7.92	7.92	7.92	7.90	0.00	0.00	-.02
..Agriculture.....	5,072	7.92	7.92	7.92	7.90	0.00	0.00	-.02
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.02)
..Urban-Related.....	48	.08	.08	.08	.10	0.00	0.00	0.02
..(Urban-Type Pop.).	(270)	-	(279)	(291)	(345)	(9)	(12)	(54)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#7 Segment Basin.....	3,840	6.00	6.00	6.00	6.00	0.00	0.00	0.00
LYON COUNTY.....	3,840	6.00	6.00	6.00	6.00	0.00	0.00	0.00
..Rural.....	3,807	5.95	5.95	5.95	5.94	0.00	0.00	-.01
..Agriculture.....	3,807	5.95	5.95	5.95	5.94	0.00	0.00	-.01
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	0.00	0.00	0.01
..Urban-Related.....	33	.05	.05	.05	.06	0.00	0.00	0.01
..(Urban-Type Pop.).	(181)	-	(186)	(194)	(230)	(5)	(8)	(36)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#8 Segment Basin.....	50,400	78.75	78.75	78.75	78.75	0.00	0.00	0.00
..Rural.....	49,139	76.74	76.57	76.39	75.59	-.17	-.18	-.80
..Agriculture.....	48,224	75.31	75.14	74.96	74.16	-.17	-.18	-.80
..Silviculture.....	864	1.35	1.35	1.35	1.35	0.00	0.00	0.00
..Mining.....	51	.08	.08	.08	.08	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.17)	(0.18)	(0.80)
..Urban-Related.....	1,261	1.97	2.14	2.32	3.12	0.17	0.18	0.80
..(Urban-Type Pop.).	(7,010)	-	(8,604)	(8,240)	(11,089)	(590)	(636)	(2,859)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
LYON COUNTY.....	8,960	14.00	14.00	14.00	14.00	0.00	0.00	0.00
..Rural.....	8,879	13.87	13.87	13.86	13.83	0.00	-.01	-.03
..Agriculture.....	8,879	13.87	13.87	13.86	13.83	0.00	-.01	-.03
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.01)	(0.03)
..Urban-Related.....	81	.13	.13	.14	.17	0.00	0.01	0.03
..(Urban-Type Pop.).	(452)	-	(467)	(485)	(575)	(15)	(18)	(90)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
CALDWELL COUNTY.....	40,960	64.00	64.00	64.00	64.00	0.00	0.00	0.00
..Rural.....	39,795	62.18	62.02	61.85	61.08	-.16	-.17	-.77
..Agriculture.....	38,880	60.75	60.59	60.42	59.65	-.16	-.17	-.77
..Silviculture.....	864	1.35	1.35	1.35	1.35	0.00	0.00	0.00
..Mining.....	51	.08	.08	.08	.08	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.16)	(0.17)	(0.77)
..Urban-Related.....	1,165	1.82	1.98	2.15	2.92	0.16	0.17	0.77
..(Urban-Type Pop.).	(6,475)	-	(7,054)	(7,672)	(10,424)	(579)	(618)	(2,752)
..P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
TRIGG COUNTY.....	480	.75	.75	.75	.75	0.00	0.00	0.00
..Rural.....	465	.73	.73	.73	.73	0.00	0.00	0.00
..Agriculture.....	465	.73	.73	.73	.73	0.00	0.00	0.00
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.00)
..Urban-Related.....	415	.02	.02	.02	.02	0.00	0.00	0.00
..(Urban-Type Pop.).	(83)	-	(83)	(83)	(90)	(0)	(0)	(7)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-

(continuation) Exhibit A-6.1t: Segment Land Use Projections

Area Breakdown	"At-Year" Figures					"Between-Year" Changes		
	1970		1975	1980	1995	1970-75	1975-80	1980-95
	Acres	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.
..#9 Segment Basin.....	92,288	144.20	144.20	144.20	144.20	0.00	0.00	0.00
..Rural.....	91,850	143.52	143.51	143.50	143.19	-.01	-.01	-.12
..Agriculture.....	91,850	143.52	143.51	143.50	143.19	-.01	-.01	-.12
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.01)	(0.01)	(0.12)
..Urban Related.....	438	.68	.69	.70	.82	0.01	0.01	0.12
..(Urban-Type Pop.).	(2,435)	-	(2,442)	(2,507)	(2,916)	(7)	(65)	(409)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
CALDWELL COUNTY.....	31,360	49.00	49.00	49.00	49.00	0.00	0.00	0.00
..Rural.....	31,247	48.83	48.82	48.82	48.79	-.01	0.00	-.03
..Agriculture.....	31,247	48.83	48.82	48.82	48.79	-.01	0.00	-.03
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.01)	(0.00)	(0.03)
..Urban-Related.....	113	.17	.18	.18	.21	0.01	0.00	0.03
..(Urban-Type Pop.).	(629)	-	(647)	(660)	(741)	(18)	(13)	(81)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
TRIGG COUNTY.....	40,960	64.00	64.00	64.00	64.00	0.00	0.00	0.00
..Rural.....	40,750	63.67	63.67	63.67	63.64	0.00	0.00	-.03
..Agriculture.....	40,750	63.67	63.67	63.67	63.64	0.00	0.00	-.03
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.03)
..Urban-Related.....	210	.33	.33	.33	.36	0.00	0.00	0.03
..(Urban-Type Pop.).	1,165	-	(1,165)	(1,165)	(1,257)	(0)	(0)	(92)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
CHRISTIAN COUNTY.....	19,968	31.20	31.20	31.20	31.20	0.00	0.00	0.00
..Rural.....	19,853	31.02	31.02	31.01	30.94	0.00	-.01	-.07
..Agriculture.....	19,853	31.02	31.02	31.01	30.94	0.00	-.01	-.07
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.01)	(0.07)
..Urban-Related.....	115	.18	.18	.19	.26	0.00	0.01	0.07
..(Urban-Type Pop.).	(641)	-	(636)	(682)	(918)	(-5)	(46)	(236)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#10 Segment Basin.....	181,280	283.25	283.25	283.25	283.25	0.00	0.00	0.00
..Rural.....	180,315	281.74	281.74	281.70	281.39	0.00	-.04	-.31
..Agriculture.....	177,627	277.54	277.54	277.50	277.19	0.00	-.04	-.31
..Silviculture.....	2,688.	4.20	4.20	4.20	4.20	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.04)	(0.31)
..Urban-Related.....	965	1.51	1.51	1.55	1.86	0.00	0.04	0.31
..(Urban-Type Pop.).	(5,365)	-	(5,347)	(5,515)	(6,633)	(0)	(168)	(1,118)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
TRIGG COUNTY.....	107,040	167.25	167.25	167.25	167.25	0.00	0.00	0.00
..Rural.....	106,502	166.41	166.41	166.41	166.34	0.00	0.00	-.07
..Agriculture.....	103,814	162.21	162.21	162.21	162.14	0.00	0.00	-.07
..Silviculture.....	2,688	4.20	4.20	4.20	4.20	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.07)
..Urban-Related.....	538	.84	.84	.84	.91	0.00	0.00	0.07
..(Urban-Type Pop.).	(2,992)	-	(2,992)	(2,992)	(3,232)	(0)	(0)	(240)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
CHRISTIAN COUNTY.....	74,240	116.00	116.00	116.00	116.00	0.00	0.00	0.00
..Rural.....	73,814	115.33	115.33	115.28	115.03	0.00	-.05	-.25
..Agriculture.....	73,814	115.33	115.33	115.28	115.03	0.00	-.05	-.25
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.05)	(0.25)
..Urban-Related.....	426	.67	.67	.72	.97	0.00	0.05	0.25
..(Urban-Type Pop.).	(2,373)	-	(2,355)	(2,523)	(3,401)	(-18)	(168)	(878)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-

(continuation) Exhibit A-6.1t: Segment Land Use Projections

Area Breakdown	"At-Year Figures"					"Between-Year" Changes		
	1970		1975	1980	1995	1970-75	1975-80	1980-95
	Acres	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.
..#11 Segment Basin.....	58,240	91.00	91.00	91.00	91.00	0.00	0.00	0.00
..Rural.....	57,842	90.38	90.38	90.34	90.12	0.00	-.04	-.22
..Agriculture.....	57,842	90.38	90.38	90.34	90.12	0.00	-.04	-.22
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.04)	(0.22)
..Urban-Related.....	398	.62	.62	.66	.88	0.00	0.04	0.22
..(Urban-Type Pop.).	(2,215)	-	(2,201)	(2,329)	(3,026)	(0)	(128)	(786)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
TRIGG COUNTY.....	1,920	3.00	3.00	3.00	3.00	0.00	0.00	0.00
..Rural.....	1,775	2.88	2.88	2.88	2.87	0.00	0.00	-.01
..Agriculture.....	1,775	2.88	2.88	2.88	2.87	0.00	0.00	-.01
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.01)
..Urban-Related.....	75	.12	.12	.12	.13	0.00	0.00	0.01
..(Urban-Type Pop.).	(416)	-	(416)	(416)	(449)	(0)	(0)	(33)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
CHRISTIAN COUNTY.....	56,320	88.00	88.00	88.00	88.00	0.00	0.00	0.00
..Rural.....	55,996	87.49	87.49	87.45	87.26	0.00	-.04	-.19
..Agriculture.....	55,996	87.49	87.49	87.45	87.26	0.00	-.04	-.19
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.04)	(0.19)
..Urban-Related.....	324	.51	.51	.55	.74	0.00	0.04	0.19
..(Urban-Type Pop.).	(1,799)	-	(1,785)	(1,913)	(2,577)	(-14)	(128)	(664)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#12 Segment Basin.....	32,000	50.00	50.00	50.00	50.00	0.00	0.00	0.00
CHRISTIAN COUNTY.....	32,000	50.00	50.00	50.00	50.00	0.00	0.00	0.00
..Rural.....	31,816	49.71	49.71	49.69	49.58	0.00	-.02	-.11
..Agriculture.....	31,688	49.51	49.51	49.49	49.38	0.00	-.02	-.11
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	128	.20	.20	.20	.20	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.02)	(0.11)
..Urban-Related.....	184	.29	.29	.31	.42	0.00	0.02	0.11
..(Urban-Type Pop.).	(1,024)	-	(1,016)	(1,089)	(1,467)	(-8)	(73)	(378)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#13 Segment Basin.....	38,400	60.00	60.00	60.00	60.00	0.00	0.00	0.00
CHRISTIAN COUNTY.....	38,400	60.00	60.00	60.00	60.00	0.00	0.00	0.00
..Rural.....	34,417	53.78	53.03	52.53	49.93	-.75	-.50	-2.60
..Agriculture.....	34,289	53.58	52.83	52.33	49.73	-.75	-.50	-2.60
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	128	.20	.20	.20	.20	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.75)	(0.50)	(2.60)
..Urban-Related.....	3,983	6.22	6.97	7.47	10.07	0.75	0.50	2.60
..(Urban-Type Pop.).	(22,145)	-	(24,834)	(26,614)	(35,861)	(2,685)	(1,780)	(9,247)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#14 Segment Basin.....	43,264	67.60	67.60	67.60	67.60	0.00	0.00	0.00
..Rural.....	40,506	63.28	62.77	62.43	60.64	-.51	-.34	-1.79
..Agriculture.....	40,378	63.08	62.57	62.23	60.44	-.51	-.34	-1.79
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	128	.20	.20	.20	.20	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.51)	(0.34)	(1.79)
..Urban-Related.....	2,758	4.32	4.83	5.17	6.96	.51	.34	1.79
..Urban-Type Pop.)..	(15,334)	-	(17,123)	(18,348)	(24,714)	(1,800)	(1,225)	(6,364)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-

(continuation) Exhibit A-6.1t: Segment Land Use Projections

Area Breakdown	"At-Year" Figures					"Between-Year" Changes		
	1970		1975	1980	1995	1970-75	1975-80	1980-95
	Acres	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.
CHRISTIAN COUNTY.....	42,240	66.00	66.00	66.00	66.00	0.00	0.00	0.00
..Rural.....	39,487	61.69	61.18	60.84	59.05	-.51	-.34	-1.79
..Agriculture.....	39,359	61.49	60.98	60.64	58.85	-.51	-.34	-1.79
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	128	.20	.20	.20	.20	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.51)	(0.34)	(1.79)
..Urban-Related.....	2,753	4.31	4.82	5.16	6.95	0.51	0.34	1.79
..(Urban-Type Pop.)	(15,305)	-	(17,094)	(18,319)	(24,684)	(1,789)	(1,225)	(6,365)
..(P/Ac/Sq.Mi.)....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
TODD COUNTY.....	1,024	1.60	1.60	1.60	1.60	0.00	0.00	0.00
..Rural.....	1,019	1.59	1.59	1.59	1.59	0.00	0.00	0.00
..Agriculture.....	1,019	1.59	1.59	1.59	1.59	0.00	0.00	0.00
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	0.00	0.00	0.00
..Urban-Related.....	5	.01	.01	.01	.01	0.00	0.00	0.00
..(Urban-Type Pop.)	(29)	-	(29)	(29)	(30)	(0)	(0)	(1)
..(P/Ac/Sq.Mi.)....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#15 Segment Basin....	12,672	19.80	19.80	19.80	19.80	0.00	0.00	0.00
..Rural.....	12,599	19.69	19.69	19.68	19.64	0.00	-.01	-.04
..Agriculture.....	12,599	19.69	19.69	19.68	19.64	0.00	-.01	-.04
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.01)	(0.04)
..Urban-Related.....	73	.11	.11	.12	.16	0.00	0.01	0.04
..(Urban-Type Pop).	(407)	-	(404)	(431)	(517)	(0)	(28)	(146)
..(P/Ac/Sq.Mi.)....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	(3,560)	(3,560)	(3,560)
CHRISTIAN COUNTY.....	12,160	19.00	19.00	19.00	19.00	0.00	0.00	0.00
..Rural.....	12,089	18.89	18.89	18.88	18.84	0.00	-.01	-.04
..Agriculture.....	12,089	18.89	18.89	18.88	18.84	0.00	-.01	-.04
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.01)	(0.04)
..Urban-Related.....	71	.11	.11	.12	.16	0.00	0.01	0.04
..(Urban-Type Pop.)	(392)	-	(389)	(417)	(562)	(-3)	(28)	(145)
..(P/Ac/Sq.Mi.)....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
TODD COUNTY.....	512	.80	.80	.80	.80	0.00	0.00	0.00
..Rural.....	509	.80	.80	.80	.80	0.00	0.00	0.00
..Agriculture.....	509	.80	.80	.80	.80	0.00	0.00	0.00
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.00)
..Urban-Related.....	3	0	0	0	0	0.00	0.00	0.00
..(Urban-Type Pop.).	(15)	-	(15)	(15)	(15)	(0)	(0)	(0)
..(P/Ac/Sq.Mi.)....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#16 Segment Basin....	20,480	32.00	32.00	32.00	0.00	0.00	0.00	0.00
..Rural.....	20,356	31.81	31.81	31.80	31.73	0.00	-.01	-.07
..Agriculture.....	20,356	31.81	31.81	31.80	31.73	0.00	-.01	-.07
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	0.00	(0.01)	(0.07)
..Urban-Related.....	124	.19	.19	.20	.27	0.00	0.01	0.07
..(Urban-Type Pop.)	(685)	-	(680)	(728)	(975)	(0)	(48)	(248)
..(P/Ac/Sq.Mi.)....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-

(continuation) Exhibit A-6.1t: Segment Land Use Projections

Area Breakdown	"At-Year" Figures					"Between-Year" Changes		
	1970		1975	1980	1995	1970-75	1975-80	1980-95
	Acres	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.
CHRISTIAN COUNTY.....	19,968	31.20	31.20	31.20	31.20	0.00	0.00	0.00
..Rural.....	19,847	31.01	31.01	31.00	30.93	0.00	-.01	-.07
..Agriculture.....	19,847	31.01	31.01	31.00	30.93	0.00	-.01	-.07
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.01)	(0.07)
..Urban-Related.....	121	.19	.19	.20	.27	0.00	0.01	0.07
..(Urban-Type Pop.)..	(670)	-	(665)	(713)	(960)	(-5)	(48)	(247)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
TODD COUNTY.....	512	.80	.80	.80	.80	0.00	0.00	0.00
..Rural.....	509	.80	.80	.80	.80	0.00	0.00	0.00
..Agriculture.....	509	.80	.80	.80	.80	0.00	0.00	0.00
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.00)
..Urban-Related.....	3	0	0	0	0	0.00	0.00	0.00
..(Urban-Type Pop.).	(15)	-	(15)	(15)	(15)	(0)	(0)	(0)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#17 Segment Basin.....	48,480	75.75	75.75	75.75	75.75	0.00	0.00	0.00
..Rural.....	48,225	75.35	75.35	75.35	75.33	0.00	0.00	-.02
..Agriculture.....	48,225	75.35	75.35	75.35	75.33	0.00	0.00	-.02
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.02)
..Urban-Related.....	255	.40	.40	.40	.42	0.00	0.00	0.02
..(Urban Pop.).....	(1,420)	-	(1,420)	(1,424)	(1,509)	(0)	(0)	(85)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
CHRISTIAN COUNTY.....	1,920	3.00	3.00	3.00	3.00	0.00	0.00	0.00
..Rural.....	1,910	2.98	2.98	2.98	2.97	0.00	0.00	-.01
..Agriculture.....	1,910	2.98	2.98	2.98	2.97	0.00	0.00	-.01
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.01)
..Urban-Related.....	10	.02	.02	.02	.03	0.00	0.00	0.01
..(Urban-Type Pop.).	(57)	-	(57)	(61)	(83)	(0)	(4)	(22)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
TODD COUNTY.....	46,560	72.75	72.75	72.75	72.75	0.00	0.00	0.00
..Rural.....	46,315	72.37	72.37	72.37	72.35	0.00	0.00	-.02
..Agriculture.....	46,315	72.37	72.37	72.37	72.35	0.00	0.00	-.02
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.02)
..Urban-Related.....	245	.38	.38	.38	.40	0.00	0.00	0.02
..(Urban-Type Pop.).	(1,363)	-	(1,363)	(1,363)	(1,426)	(0)	(0)	(63)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#18 Segment Basin.....	31,392	49.05	49.05	49.05	49.05	0.00	0.00	0.00
..Rural.....	31,214	48.77	48.77	48.77	48.76	0.00	0.00	-.01
..Agriculture.....	31,214	48.77	48.77	48.77	48.76	0.00	0.00	-.01
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.01)
..Urban-Related.....	178	.28	.28	.28	.29	0.00	0.00	0.01
..(Urban-Type Pop.).	(986)	-	(986)	(988)	(1,037)	(0)	(0)	(49)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-

(continuation) Exhibit A-6.1t: Segment Land Use Projections

Area Breakdown	"At-Year" Figures					"Between-Year" Changes		
	1970		1975	1980	1995	1970-75	1975-80	1980-95
	Acres	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.
CHRISTIAN COUNTY.....	1,024	1.60	1.60	1.60	1.60	0.00	0.00	0.00
..Rural.....	1,019	1.59	1.59	1.59	1.59	0.00	0.00	0.00
..Agriculture.....	1,019	1.59	1.59	1.59	1.59	0.00	0.00	0.00
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	0.00	0.00	0.00
..Urban-Related.....	5	.01	.01	.01	.01	0.00	0.00	0.00
..(Urban-Type Pop.).	(29)	-	(29)	(31)	(41)	(0)	(2)	(10)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
TODD COUNTY.....	30,368	47.45	47.45	47.45	47.45	0.00	0.00	0.00
..Rural.....	30,195	47.18	47.18	47.18	47.17	0.00	0.00	-.01
..Agriculture.....	30,195	47.18	47.18	47.18	47.17	0.00	0.00	-.01
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.01)
..Urban-Related.....	173	.27	.27	.27	.28	0.00	0.00	0.01
..(Urban-Type Pop.).	(957)	-	(957)	(957)	(996)	(0)	(0)	(39)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#19 Segment Basin.....	67,840	106.00	106.00	106.00	106.00	0.00	0.00	0.00
..Rural.....	67,494	105.46	105.45	105.44	105.39	-.01	-.01	-.05
..Agriculture.....	67,494	105.46	105.45	105.44	105.39	-.01	-.01	-.05
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.01)	(0.01)	(0.05)
..Urban-Related.....	346	.54	.55	.56	.61	0.01	0.01	0.05
..(Urban-Type Pop.).	(1,931)	-	(1,960)	(1,981)	(2,149)	(.29)	(.21)	(185)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..TODD COUNTY.....	52,480	82.00	82.00	82.00	82.00	0.00	0.00	0.00
..Rural.....	52,198	81.56	81.56	81.56	81.54	0.00	0.00	-.02
..Agriculture.....	52,198	81.56	81.56	81.56	81.54	0.00	0.00	-.02
..Silviculture.....	52,198	81.56	81.56	81.56	81.54	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.02)
..Urban-Related.....	282	.44	.44	.44	.46	0.00	0.00	0.02
..(Urban-Type Pop.).	(1,580)	-	(1,580)	(1,580)	(1,650)	(0)	(0)	(70)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
LOGAN COUNTY.....	15,360	24.00	24.00	24.00	24.00	0.00	0.00	0.00
..Rural.....	15,296	23.90	23.89	23.88	23.85	-.01	-.01	-.03
..Agriculture.....	15,296	23.90	23.89	23.88	23.85	-.01	-.01	-.03
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.01)	(0.01)	(0.03)
..Urban-Related.....	64	.10	.11	.12	.15	0.01	0.01	0.03
..(Urban-Type Pop.).	(351)	-	(380)	(401)	(499)	(29)	(21)	(98)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#20 Segment Basin.....	206,784	323.10	323.10	323.10	323.10	0.00	0.00	0.00
..Rural.....	205,850	321.64	321.54	321.48	321.17	-.10	-.06	-.31
..Agriculture.....	205,754	321.49	321.39	321.33	321.02	-.10	-.06	-.31
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	96	.15	.15	.15	.15	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.10)	(0.06)	(0.31)
..Urban-Related.....	934	1.46	1.56	1.62	1.93	0.10	0.06	0.31
..(Urban-Type Pop.).	(5,175)	-	(5,471)	(5,724)	(6,966)	(352)	(221)	(1,098)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-

(continuation) Exhibit A-6.1t: Segment Land Use Projections

Area Breakdown	"At-Year" Figures					"Between-Year" Changes		
	1970		1975	1980	1995	1970-75	1975-80	1980-95
	Acres	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.	Sq.Mi.
LOGAN COUNTY.....	135,040	211.00	211.00	211.00	211.00	0.00	0.00	0.00
..Rural.....	134,368	209.95	209.89	209.83	209.54	-.06	-.06	-.29
..Agriculture.....	134,272	209.80	209.74	209.68	209.39	-.06	-.06	-.29
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	96	.15	.15	.15	.15	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.06)	(0.06)	(0.29)
..Urban-Related.....	672	1.05	1.11	1.17	1.46	0.06	0.06	0.29
..(Urban-Type Pop.).	(3,728)	-	(3,925)	(4,137)	(5,151)	(197)	(212)	(1,014)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
TODD COUNTY.....	25,088	39.20	39.20	39.20	39.20	0.00	0.00	0.00
..Rural.....	24,954	38.90	38.99	38.99	38.98	0.00	0.00	-.01
..Agriculture.....	24,954	38.99	38.99	38.99	38.98	0.00	0.00	-.01
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.01)
..Urban-Related.....	134	.21	.21	.21	.22	0.00	0.00	0.01
..(Urban-Type Pop.).	(754)	-	(754)	(754)	(787)	(0)	(0)	(33)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
SIMPSON COUNTY.....	46,656	72.90	72.90	72.90	72.90	0.00	0.00	0.00
..Rural.....	46,528	72.70	72.67	72.66	72.60	-.03	-.01	-.06
..Agriculture.....	46,528	72.70	72.67	72.66	72.60	-.03	-.01	-.06
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.03)	(0.01)	(0.06)
..Urban-Related.....	128	.20	.23	.24	.30	0.03	0.01	0.06
..(Urban-Type Pop.).	(693)	-	(792)	(833)	(1,028)	(99)	(41)	(195)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#21 Segment Basin.....	1,920	3.00	3.00	3.00	3.00	0.00	0.00	0.00
LOGAN COUNTY.....	1,920	3.00	3.00	3.00	3.00	0.00	0.00	0.00
..Rural.....	1,912	2.99	2.99	2.99	2.99	0.00	0.00	0.00
..Agriculture.....	1,912	2.99	2.99	2.99	2.99	0.00	0.00	0.00
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.00)
..Urban-Related.....	8	.01	.01	.01	.01	0.00	0.00	0.00
..(Urban-Type Pop.).	(45)	-	(49)	(52)	(64)	(4)	(3)	(12)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	(3,560)	(3,560)	(3,560)	-	-	-
..#22 Segment Basin.....	512	.80	.80	.80	.80	0.00	0.00	0.00
SIMPSON COUNTY.....	512	.80	.80	.80	.80	0.00	0.00	0.00
..Rural.....	510	.80	.80	.80	.80	0.00	0.00	0.00
..Agriculture.....	510	.80	.80	.80	.80	0.00	0.00	0.00
..Silviculture.....	0	0	0	0	0	0.00	0.00	0.00
..Mining.....	0	0	0	0	0	0.00	0.00	0.00
..Construction.....	-	-	-	-	-	(0.00)	(0.00)	(0.00)
..Urban-Related.....	2	0	0	0	0	0.00	0.00	0.00
..(Urban-Type Pop.).	(8)	-	(9)	(9)	(12)	(1)	(0)	(3)
..(P/Ac/Sq.Mi.).....	(5.56/Ac)	(3,560)	-	-	-	-	-	-

SURFACE AREA DISAGGREGATION

INTRODUCTION

Surface area measurements generally are available only at the county level, and, as shown by Exhibit A-7m, the L.C.R.B. boundaries do not coincide with the county boundaries. Thus, it is necessary to disaggregate the county figures in order to secure measurements for what is inside the L.C.R.B.

The county figures were taken from the U.S. Census "Area Measurement Report, 1970". Maps prepared by the Army Map Service at 1:250,000 scale (1" = ± 4 miles) were planemetered six times, averaged, and, if necessary, porportionately forced to conform to the U.S. Census totals.

The surface area measurements for each county and the disaggregation to the LCRB are shown by Exhibit A-7m and A-7.1t. Kentucky's total surface area is listed as 40,395 square miles comprised of 39,851 sq. mi. of land, and 544 sq. mi. of water. Similar figures for the L.C.R.B. counties are Livingston 342 total = 311.7 land + 30.3 water; Crittenden 376 = 364.5 + 11.5; Lyon 263 = 252.8 + 10.3; Caldwell 726 = 725.2 + 0.7; Todd 376 = 376.5 + 0.5; Logan 563 = 562.7 + 0.3; and Simpson 239 = 238.9 + 0.1. The exhibits use the total surface area figures.

Exhibit A-7.1t: Surface Area Breakdown for L.C.R.B.

County breakdown	Total Surface Area		% of total*
	Acres	Sq. Mi.*	
Nine-County Total	2,374,400	3,710	100%
-Outside LCRB	1,040,640	1,653	44
-Inside LCRB	1,333,760	2,057	56
Livingston Co. total	218,800	342	100%
-Outside LCRB	132,800	208	61
-North of LCRB	93,120	146	43
-South of LCRB	39,680	62	18
-Inside LCRB	86,080	134	39
Crittenden Co. Total	240,640	376	100%
-Outside LCRB (north)	185,728	290	77
-Inside LCRB	54,912	86	23
Lyon County total	168,320	263	100%
-Outside LCRB (south)	21,760	34	13
-Inside LCRB	146,560	229	87
Caldwell Co. total	228,480	357	100%
-Outside LCRB (north)	127,140	199	56
-Inside LCRB	101,376	158	44
Trigg County total	299,520	468	100%
-Outside LCRB (south)	8,960	41	3
-Inside LCRB	290,560	427	97
Christian Co. total	464,640	726	100%
-Outside LCRB (north)	166,400	260	36
-Inside LCRB	298,240	466	64
Todd County total	240,640	376	100%
-Outside LCRB (north)	84,096	131	35
-Inside LCRB	156,544	245	65
Logan County total	360,320	563	100%
-Outside LCRB (north)	208,000	325	58
-Inside LCRB	152,320	238	42
Simpson Co. total	152,960	239	100%
-Outside LCRB (north)	105,792	165	69
-Inside LCRB	47,168	74	31
		*rounded	

Exhibit A-7m: Surface Area Measurements for Lower Cumberland River Basin, by County

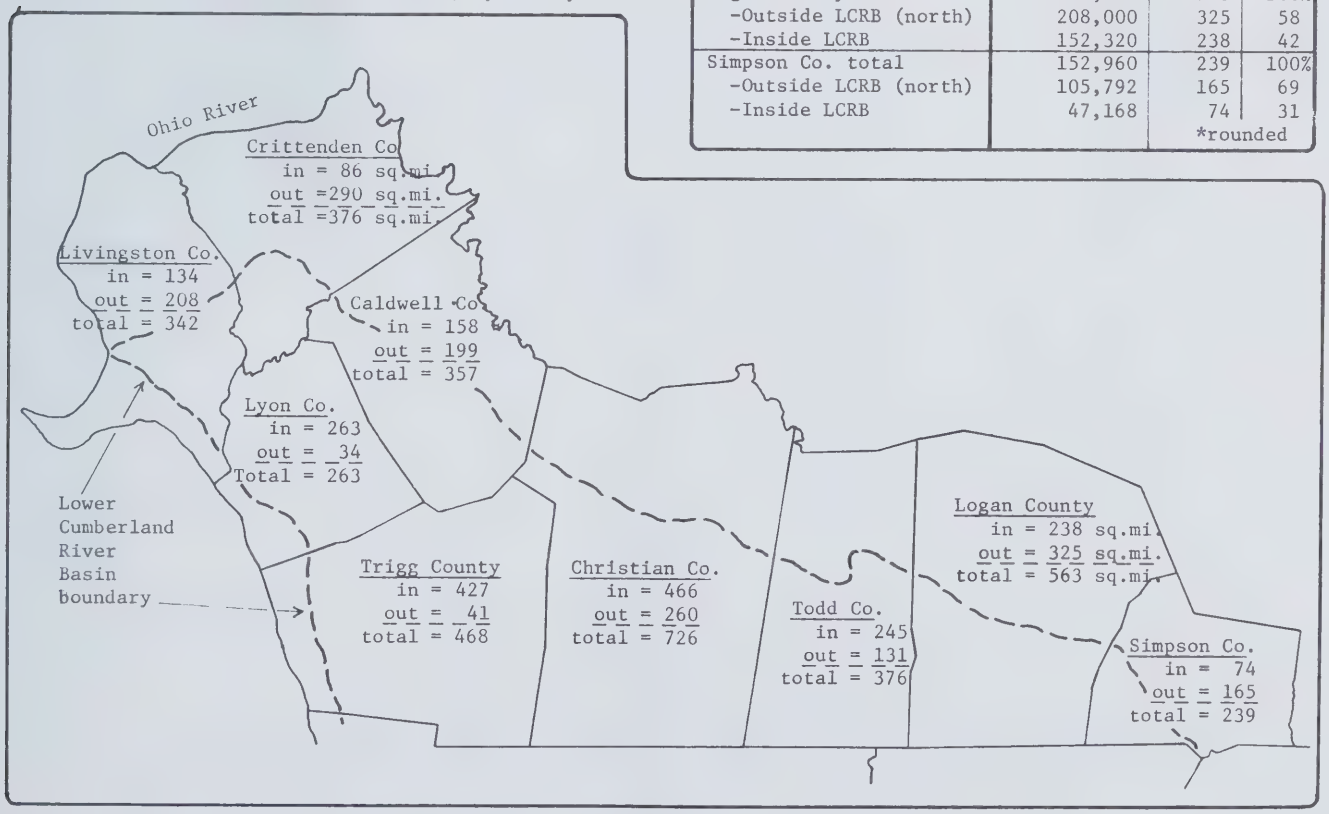


Exhibit A-7.2t - Surface Area By County Within The Lower Cumberland River Basin (LCRB)

COUNTY BREAKDOWN	SURFACE AREA* ACREAGE	SURFACE AREA* SQ. MI.	% Of KY.	% Of Nine Co. Total	% Of LCRB	% Of Each County	% Of Co. In LCRB
STATE OF KENTUCKY	25,852,800	40,395		--	--	--	--
Nine County Total	2,374.400	3,710	9.2%	100%	--	--	--
-Outside LCRB	1,057,940	1,653	4.0%	44%	--	--	--
-Inside LCRB	1,316,460	2,057	5.2%	56%	100%	--	--
Livingston County Total	218,880	342	.8%	9.2%	--	100%	--
-Outside LCRB	132,800	207.5	.5	5.6	--	61%	--
-North of LCRB	93,120	145.5	--	4.0	--	43	--
-South of LCRB	39,680	62	--	1.6	--	18	--
-Inside LCRB	86,080	134.5	.3%	3.6%	6.4%	39	100%
#1 segment basin	48,064	75.1	--	2	3.6	22	56%
#2 segment basin	22,528	35.2	--	1	1.7	10	26.2%
#4 segment basin	14,720	23	--	.6	1.1	6.6	16.9%
#5 segment basin	768	1.2	--	.03	.06	.4	.9%
Crittenden County Total	240,640	376	.9	10.1%	--	100%	--
-Outside LCRB (north)	185,728	290.2	.7	7.8%	--	77	--
-Inside LCRB	54,912	85.8	.2	2.3	4.1%	23%	100%
#1 segment basin	29,568	46.2	--	1.2	2.2	12.2	54%
#2 segment basin	2,048	3.2	--	.1	.15	.8%	4
#3 segment basin	23,296	36.4	--	1	1.8	10	42
Lyon County Total	168,320	263	.7	7.1%	--	100%	--
-Outside LCRB (south)	21,760	34	.1	.9	--	13	--
-Inside LCRB	146,560	229	.6	6.2	11%	87	100%
#3 segment basin	27,520	43	--	1.2	2.1	16.3	19
#4 segment basin	12,800	20	--	.5	.9	7.6	9
#5 segment basin	88,320	138	--	3.7	7	52.5	60
#6 segment basin	5,120	8	--	.2	.4	3	4
#7 segment basin	3,840	6	--	.2	.3	2.3	2
#8 segment basin	8,960	14	--	.4	.7	5.3	6
Caldwell County Total	228,480	357	.9	9.6%	--	100%	--
-Outside LCRB (north)	127,104	198.6	.5	5.3%	--	56	--
-Inside LCRB	101,376	158.4	.4	4.3%	7.6%	44	100%
#3 segment basin	14,080	22	--	.6%	1	6.0	14
#5 segment basin	14,976	23.4	--	.6	1.1	6.5	15
#8 segment basin	40,960	64	--	1.8	3.1	17.8	40
#9 segment basin	31,360	49	--	1.3	2.3	13.7	31
Trigg County Total	299,520	468	1.2	12.6%	--	100%	--
-Outside LCRB (south	26,240	41	.1	1.1	--	8.8%	--
-Inside LCRB	273,280	427	1.1	11.5	20.5%	91.2	100%
#5 segment basin	122,880	192	--	5.2	9.2	41	45
#8 segment basin	480	.75	--	.02	.04	.16	.18
#9 segment basin	40,960	64	--	1.7	3.1	13.7	15
#10 segment basin	107,040	167.25	--	4.5	8.02	35.7	39.17
#11 segment basin	1,920	3	--	.08	.14	.64	.7
Christian County Total	464,640	726	1.8	19.6	--	100%	--
-Outside LCRB (north)	166,400	260	.6	7	--	36	--
-Inside LCRB	298,240	466	1.2	12.6	22.4%	64	100%
#9 segment basin	19,960	31.2	--	.84	1.5	4.3	6.7
#10 segment basin	74,240	116	--	3.1	6	15.9	24.8
#11 segment basin	56,320	88	--	2.4	4.2	12	18.8
#12 segment basin	32,000	50	--	1.4	2.4	7	10.7
#13 segment basin	38,400	60	--	1.6	3	8.3	12.8
#14 segment basin	42,240	66	--	1.8	3.2	9	14.2
#15 segment basin	12,160	19	--	.5	.9	2.6	4.1
#16 segment basin	19,968	31.2	--	.84	1.5	4.3	7
#17 segment basin	1,920	3	--	.08	.15	.4	.6
#18 segment basin	1,024	1.6	--	.04	.08	.2	.3

(con't) Exhibit A-7.2t - Surface Area By County Within The Lower Cumberland River Basin (LCRB)

COUNTY BREAKDOWN	SURFACE AREA* ACREAGE	SURFACE AREA* SQ. MILE	%Of KY.	% Of Nine Co. Total	% Of LCRB	% Of Each County	% Of Co. In LCRB
Todd County Total	240,640	376	.9	10.1		100%	--
-Outside LCRB (North)	84,096	131.4	.3%	35	--	35%	--
-Inside LCRB	156,544	244.6	.6	6.6	12%	65%	100%
#14 segment basin	1,024	1.6	--	.04	.08	.4	.6
#15 segment basin	512	.8	--	.02	.04	.2	.3
#16 segment basin	512	.8	--	.02	.04	.2	.3
#17 segment basin	46,560	72.75	--	1.94	3.8	19.4	29.7
#18 segment basin	30,368	47.45	--	1.26	2.4	12.6	19.4
#19 segment basin	52,480	82	--	2.2	4	21.8	33.5
#20 segment basin	25,088	39.2	--	1.1	2	10.4	16
Logan County Total	360,320	563	1.4%	15.2%	--	100%	--
-Outside LCRB (north)	208,000	325	.8	8.8	--	58	--
-Inside LCRB	152,320	238	.6	6.4	11.4	42	100%
#19 segment basin	15,360	24	--	.6	1.1	4.1	10.1
#20 segment basin	135,040	211	--	5.7	10.1	37.4	88.6
#21 segment basin	1,920	3	--	.08	.15	.5	1.3
Simpson County Total	152,960	239	.6%	6.4	--	100%	--
Outside LCRB (north)	105,792	165.3	.4	4.4	--	69.2	--
-Inside LCRB	47,168	73.7	.2	2.0	3.5	30.8	100%
#20 segment basin	46,656	72.9	--	1.9	3.5	30.5	98.9
#22 segment basin	512	.8	--	.02	.04	.3	1.1

*Includes land and water surface, State and County totals are from the U.S. Census "Area Measurement Reports," 1970. County breakdowns were secured by planimetering the 1: 250,000 scale (1" = ± 4 miles) maps prepared by the Army Map Service, U.S. Corps of Engineers. Kentucky's total area is listed as 40,395 square miles, comprised of 39,851 sq. in. of land area, and 544 sq. mi. of water area. Similar figures for the L.C.R.B. counties are Livingston: 342 total = 311.7 land + 30.3 water; Crittenden 376 = 364.5 + 11.5; Lyon 263 = 252.8 + 10.3; Caldwell 357 = 356.9 + 0.1; Trigg 468 = 458.8 + 9.2; Christian 726 = 725.2 + 0.7; Todd 376 = 375.5 + 0.5; Logan 563 = 562.7 + 0.3; Simpson 239 = 238.9 + 0.1.

Exhibit A-7.3t - Surface Area By Segment Basin Within The Lower Cumberland River Basin (LCRB)

BASIN & SEGMENT SUB-BASIN	SURFACE AREA		% Of LCRB	% Of SEGMENT BASIN
	ACREAGE	SQ. MILES		
Lower Cumberland Basin Total	1,316.460	2,057	100%	NA
#1 Segment Basin	77,632	121.3	5.8%	100%
-In Livingston Co.	48.064	75.1	3.6	62
-In Crittenden Co.	29,568	46.2	2.2	38
#2 Segment Basin	24,576	38.4	1.8%	100%
-In Livingston Co.	22,528	35.2	1.7	92
-In Crittenden Co.	2,048	3.2	.1	8
#3 Segment Basin	64,896	101.4	4.9%	100%
-Crittenden Co.	23,296	36.4	1.8	36
-Caldwell	14,080	22.0	1.0	22
-Lyon	27,520	43.0	2.1	42
#4 Segment Basin	27,520	43	2.1%	100%
-Lyon Co.	12,800	20	1	47
-Livingston Co.	14,720	23	1.1	53
#5 Segment Basin	226,944	354.6	17.0%	100%
-Lyon Co.	88,320	138.0	6.6	39
-Trigg Co.	122,880	192	9.2	54
-Caldwell Co.	14,976	23.4	1.1	6.6
-Livingston Co.	768	1.2	.06	.3
#6 Segment Basin	5,120	8.0	.4%	100%
-Lyon Co.	5,120	8.0	.4%	100
#7 Segment Basin	3,840	6.0	.3%	100%
-Lyon Co.	3,840	6.0	.3	100
#8 Segment Basin	50,400	78.75	3.8%	100
- Lyon Co.	8,960	14.0	.7	17.8
-Caldwell Co	40,960	64.0	3.1	81.3
-Trigg	480	.75	.04	.9
#9 Segment Basin	92,288	144.2	7.0%	100%
-Caldwell Co.	31,360	49	2.4	34
-Trigg	40,960	64	3.1	44
-Christian Co.	19,968	31.2	1.5	22
#10 Segment Basin	181,280	283.25	13.6%	100%
-Trigg Co	107,040	167.25	8	59
-Christian	74,240	116	5.6	41
#11 Segment Basin	58,240	91	4.36%	100%
-Trigg Co.	1,920	3	14	3.3
-Christian Co.	56,320	88	4.2	96.7
#12 Segment Basin	32,000	50	2.4%	100%
-Christian Co.	32,000	50	2.4	100%
#13 Segment Basin	38,400	60	2.9%	100%
-Christian Co.	38,400	60	2.9	100
#14 Segment Basin	43,264	67.6	3.2%	100%
-Todd Co.	1,024	1.6	.08	2.4
-Christian Co.	42,240	66	3.12	97.6
#15 Segment Basin	12,672	19.8	.95%	100%
-Christian Co.	12,160	19	.9	96
-Todd Co.	512	.8	.04	4
Todd North	192	.3	.01	1.5
Todd South	320	.5	.02	2.5
#16 Segment Basin	20,480	32	1.5%	100%
-Christian Co.	19,968	31.2	1.5	97.5
-Todd Co.	512	.8	.04	2.5
Todd North	320	.8	.02	1.6
Todd South	192	.3	.01	.9

(con't) Exhibit A-7.3t-Surface Area Segment Basin Within The Lower Cumberland River Basin (LCRB)

BASIN & SEGMENT SUB BASIN	SURFACE AREA ACREAGE	SURFACE AREA SQ. MILES	% Of LCRB	% Of SEGMENT BASIN
#17 Segment Basin	48,480	75.8	3.6%	100%
-Christian Co.	1,920	3	.1	6
Christian North	1,280	2	.1	4
Christian Middle	512	.8	.04	1.6
Christian South	128	.2	.02	.4
-Todd Co.	46,560	72.8	3.5	94
#18 Segment Basin	31,392	49.1	2.4	100%
-Todd Co.	30,368	47.5	2.3	97
-Christian Co.	1,024	1.6	.1	3
#19 Segment Basin	67,840	106	5.1	100%
-Todd Co.	52,480	82	4	77
-Logan Co.	15,360	24	1.1	23
#20 Segment Basin	206,784	323.1	15.5	100%
-Todd Co.	25,086	39.2	1.9	12
-Logan Co.	135,040	211	10.1	65
-Simpson Co.	46,656	72.9	3.5	23
#21 Segment Basin	1,920	3	.1	100%
-Logan Co.	1,920	3	.1	100%
#22 Segment Basin	512	.8	.04	100%
-Simpson Co.	512	.8	.04	100%

Appendix "B": LOWER CUMBERLAND RIVER BASIN

SEGMENT ANALYSES

INTRODUCTION

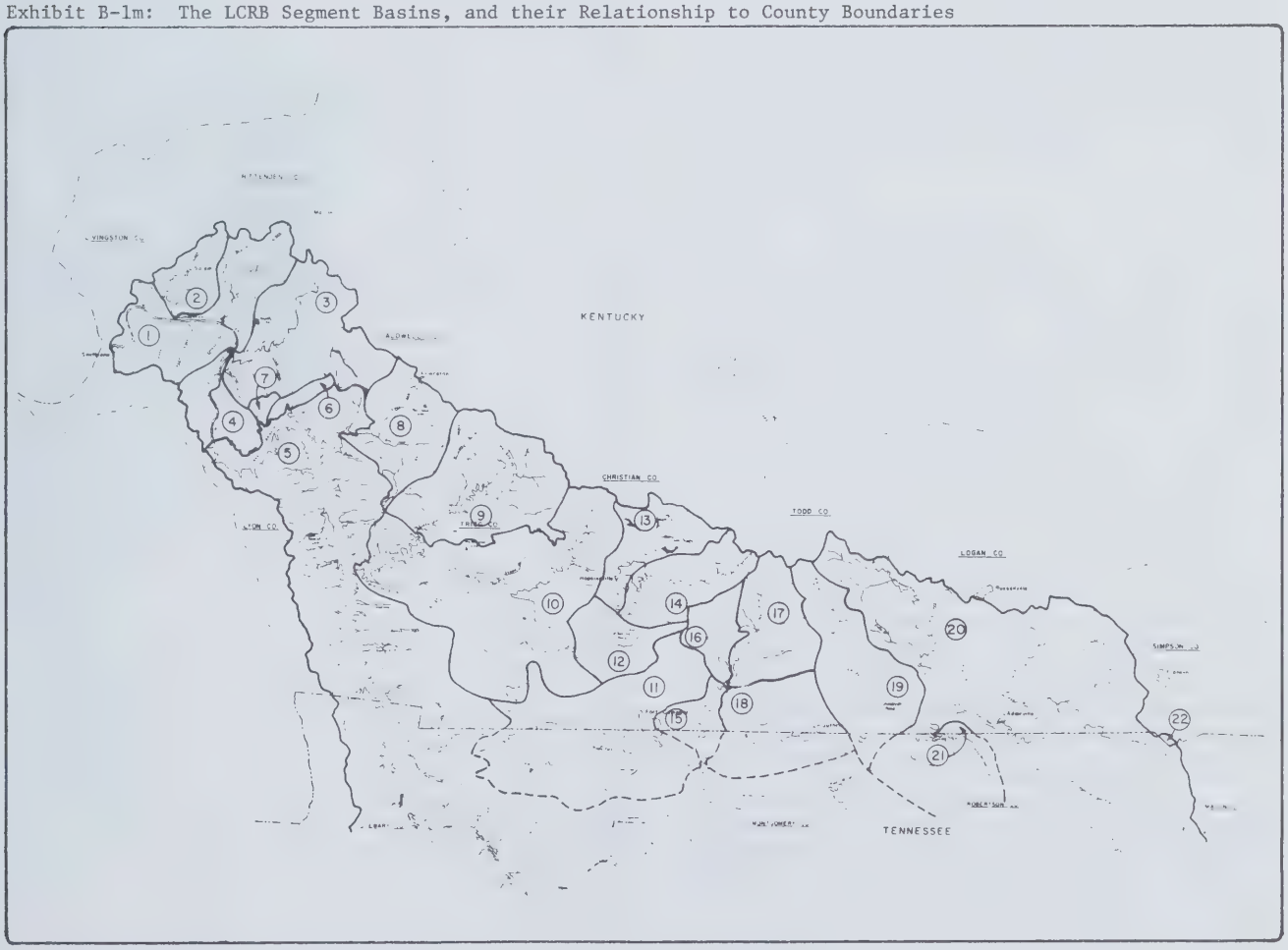
The Lower Cumberland River Basin (LCRB) has been subdivided into twenty-two separate areas, or segment basins, for convenience in obtaining a level of detail sufficient to predict future needs for individual streams or areas. Exhibit B-1m shows the LCRB, its twenty-two segment basin subdivisions (numbered 1 through 22), and the Kentucky Counties, and some of the State of Tennessee Counties, served by the LCRB.

Although some of the segment basins extend into Tennessee, such extensions are not given consideration within this present study.....with the scope of the present study being restricted to consideration of the LCRB within the State of Kentucky. It is assumed that future coordinated efforts between the two States will develop any additional information or programs needed for water quality management.

Definition of Segment Basins

The twenty-two segment basins are physically defined as that area which immediately contributes to the volume of flow in a stream. Each of these areas has been analyzed with respect to its seven-day, ten-year low flow value, and its potential for dilution and disposal of wastewater from municipal, industrial, domestic, and non-point discharges. The analyses relied heavily on data collected from various state agencies pertaining to dischargers, their locations, and their discharge characteristics. These data were often found inadequate or incomplete. The data presented in this Appendix are to be construed only as the best recorded, or estimated, values which were available at the time of this writing. The values presented are subject to change daily and can only be used to approximate the conditions which are physically evident in the river basin.

Exhibit B-1m: The LCRB Segment Basins, and their Relationship to County Boundaries



General

Each of the twenty-two segments was analyzed to assess its present water quality. These analyses follow in this Appendix, giving the segment location and description, the basic planning, hydrology, and water quality data, point and non-point discharge descriptions and locations in the basin municipal needs for achieving required treatment levels, and alternative methods for achieving treatment requirements.

Individual maps are not provided for each segment basin in the later parts of this Appendix. Rather, the twenty-two segments were combined into four groups, and one map was prepared for each grouping. As a result:

..Exhibit B- 1.1m includes segments # 1-# 4
..Exhibit B- 5.1m includes segments # 5-#10
..Exhibit B-11.1m includes segments #11-#19
..Exhibit B-20.1m includes segments #20-#22

Existing Water Quality

Available data, giving characteristics of stream water, were scarce and of questionable reliability. Both chemical and physical water quality characteristics were taken from the U.S.E.P.A. STORET retrieval system. This computerized system records and performs statistical analyses on information from various monitoring stations throughout the country. Only thirteen stations in the LCRB had data recorded in the STORET system. Of these available stations, five had only one sampling date listed and the remainder were for short time periods. This data is, at best, a mere sketch of the water quality in the basin.

Waste Load Allocations

Maximum theoretical daily loads and total maximum daily loads were calculated using the existing discharge characteristics and formulas prepared by the University of Kentucky and University of Louisville computer modelling team, and approved by the Design and Hydrology Sub-committee of the Kentucky River Basins Water Quality Management Study Group.

Total maximum daily waste loads for each discharger were computed using the formula:

$$TMDL = 8.34\ Q_i\ TOD_i$$

The term "Q_i" represents the estimated 1980 flow for the "i^{th}" discharge, and "TOD_i" is the theoretical oxygen demand in mg/l which would result in non-violation of stream ammonia (NH_3) and dissolved oxygen (D.O.) standards for the required 1980 treatment level. The resulting value gives the maximum waste load in lbs/day which can be discharged and still meet the applicable stream standards. The sum of the individual discharge maximum loads in the segment gives the maximum segment daily load allowable for the segment. This value is constant within a segment for the assumed 1980 flows and required treatment levels; but, addition to or deletion from the number of existing dischargers would modify this waste load allocation due to the interaction of waste loads as they come together downstream.

Maximum theoretical daily loads are a measure of the streams natural ability to dispose of wastewater. This value depends heavily on the volume of stream flow and its velocity. This maximum theoretical daily load assumes a uniform application rate of waste load along the reach of the stream equal to the assimilative rate of the stream. This is a theoretical value which can be approached somewhat by spacing smaller discharges along the stream. The value of spacing discharges along a stream having Q10-7 equal to zero would be minimal since stream dilution would not be available.

The maximum theoretical daily load is calculated using the formula:

$$MTDL = 17.2\ k_a\ t\ Q$$

where "Q" is average stream flow, "t" is time of travel through the reach, and "k_a" is the reaeration coefficient which is dependent upon the stream slope and channel depth.

Segment and Facility Priorities

Segment and facility priorities are indicators showing what areas are in greatest need of improved waste treatment and the relative need among individual dischargers. The segment and facility priorities are calculated as shown in Chapter IV. The facility priorities are calculated only for publicly-owned facilities and will be used in determining the order of funds distribution for design and construction of required facilities. These individual priorities are tabulated and shown, along with the discussion of the segments, later in this Appendix.

Municipal Needs

Later discussion of each segment will include the determination of treatment needs to meet compliance goals (1980 and 1995), and expressed in 1975 dollars.

Alternative Water Quality Management Plans

For each segment, discussion will include: regional approaches of consolidating discharges for treatment, package plant applications, non-point source controls, costs of feasible alternatives, recommendations for revising water quality standards, nutrient control requirements for impoundments, and the effect of related planning on solving water quality problems in the segment.

SEGMENT #1 ANALYSIS

Classification: Effluent Limited Priority: 76.94

Location

As shown by Exhibit B-1.1m, Segment Basin #1 is located in Livingston and Crittenden Counties. The basin contains 121.3 square miles of surface area (including water), and 62 percent of the area is in Livingston County. A portion of Smithland (Livingston Co.) is in this basin. In Crittenden County, Dycusburg is the largest (pop. 89) place included within the LCRB.

Basic Planning Data

As shown by Exhibit B-1.2t, this segment is projected to add 470 persons and 267 housing units, between 1970 and 1995. No new employment opportunities are projected for this segment basin. Population density is projected to increase by 20%, or four persons per square mile. Urban-related land use (reflecting rural non-farm growth) is expected to grow from 0.24 square miles in 1970 to 0.29 by 1995.

Exh. B-1.2t: Segment #1 Basic Planning Data*1

	1970	1975	1980	1995
Population Total	2,352	2,420	2,489	2,831
..Rural	2,352	2,420	2,489	2,831
..Farm	1,491	1,537	1,584	1,810
..Non-Farm	861	883	905	1,021
..Urban	0	0	0	0
Population Density ..Persons/sq.mi.	19.38	19.95	20.52	23.34
Housing Units	823	880	946	1,090
..Rural	823	880	946	1,090
..Urban	0	0	0	0
Non-Ag. Employment	-	-	-	-
..Manufacturing	-	-	-	-
..Non-Manufacturing	-	-	-	-
Land Use Total (sq.mi.)	121.30	121.30	121.30	121.30
..Rural	121.06	121.05	121.04	121.01
..Agriculture	118.99	118.98	118.97	118.94
..Silviculture	1.64	1.64	1.64	1.64
..Mining	0.43	0.43	0.43	0.43
..Construction	-	-	-	-
..Urban-Related	.24	.25	.26	.29

Segment Hydrology

Segment 1, as shown by Exhibit B-1.1m, includes the Cumberland River and its tributaries from its confluence with the Ohio River to its confluence with Livingston Creek at M.P. 20.6. Main tributaries flowing into this section of streams are McCormick Creek at MP 3.80 and Claylick Creek at M.P. 17.10. Other minor tributaries include Bissell Creek, M.P. 9.40; Hickory Creek, M.P. 12.30; Sugar Creek, M.P. 13.80, and Cypress Creek, M.P. 16.80.

Seven-day, ten-year low flow (Q7-10) values are zero on all the tributaries. Low-flow in the Cumberland River is 5087 cfs due to flow augmentation in dry weather from Barkley Dam. This flow is low compared to average daily flows which are in excess of 25,000 cfs.*2 The most critical flow situations arise only during periods of repair to Barkley Dam. These repair periods rarely last more than one week.

Water Quality Data

Water quality in segment 1 is excellent in the main stem of the Cumberland River. This is primarily due to the lack of large discharges in this segment and to the dilution factor provided by the extremely high flow augmentation from Lake Barkley. All the recorded point discharges are located on McCormick Creek near the confluence of Cumberland River with the Ohio River. Although the main stem of segment 1 is Effluent Limited, McCormick Creek has been classified a Water Quality Limited subreach due to the violations of D.O. Standards imposed on the stream by Smithland sewage treatment plant and Smithland Elementary School. Rural areas within the segment are served by septic field installations. These factors contribute to the general groundwater pollution in the segment but cannot be readily analyzed as to their severity due to the lack of specific data on septic field installations. Overall water quality in segment 1 is very good. The only gaging station in the segment is located at Smithland and values here are probably affected by the Ohio River backwater during periods of high flow. Therefore, qualitative data must be generated from upstream gage data in order to compare actual water quality with the stream standards. Claylick Creek is one of four streams in the LCRB which has been designated a trout stream. In effect, this implies that dischargers who might eventually locate near Claylick Creek will have to meet the rigid temperature and D.O. standards set for Kentucky trout streams. (See Appendix C)

Point Source Discharges

Exhibit B-1.3t shows existing point discharge characteristics for 1975. A brief discussion of each discharger follows:

Smithland, a small community with approximately 324 people has an aerobic lagoon capable of treating 70,000 gpd with primary treatment only. Presently, the Smithland sewage treatment plant is operating at 32,000 gpd average flow. Projections for 1980 and

*1 For additional information on basic planning data, see Appendix A.
*2 Water in Kentucky, Kreiger, Cushman, Thomas.

1995 show that the plant flow due to population increase will probably be 33,400 gpd and 38,400 gpd respectively. Should Smithland continue to discharge into McCormick Creek, plant upgrading will be required by 1977. This is primarily due to the stream standards set by PL-92-500 requiring municipalities to have at least secondary treatment facilities by July 1, 1977. In order to meet minimum D.O. requirements in McCormick Creek for 1980 and 1995 as determined by the computer model and shown in Exhibit B-1.4t, Smithland would need to install a plant capable of producing 95% removal of BOD and SS, and a D.O. content of 8 mg/1.

Smithland Elementary School presently uses a settling tank and sand filter system and discharges to McCormick Creek. Treatment capacity is 2800 gpd with no average flow values available. It is anticipated that with the issuance of an NPDES permit, this discharge will be required to meet the same treatment level as Smithland STP after 1977.

Industrial Minerals Co., Inc., has been issued a permit to discharge wastewater containing suspended solids to McCormick Creek. No average daily flow values were available for this discharge and no qualitative data has been analyzed to indicate the nature of the solids discharge.

Non-Point Source Discharges

No severe non-point sources have been identified for segment 1. However, several potential sources could possibly be verified with extensive field data collection. These non-point sources consist mostly of old mines or quarries which could possibly have some acid drainage or excess metals in solution. These mines are not all active and some have been abandoned for several years. These potential non-point sources of pollution are shown on Exhibit B1.1m. Principle areas found in this area are flourspar, sphalerite, barite, and limestone. Water quality reported in the 1975 Water Quality Report to Congress, by the Division of Water Quality showed no excessive acidity in the Cumberland River. No monitoring stations were located on Hickey, Bissell, or Claylick Creeks where the mining activities are concentrated as shown on Exhibit B-1.1m. Therefore, the volume of pollutants from these wastes and their character can only be estimated. No BOD loading would be expected from those mining areas, but suspended solids concentrations could be high during periods of heavy rainfall runoff. This loading could hardly be called significant to the water quality without the addition of several monitoring stations in the areas of concern.

Most of this segment land area is utilized for agricultural purposes with small localized areas of silvicultural operation (forestry). These areas contribute some non-point pollution loads consisting of silt, fertilizers, pesticides and animal waste runoff during times of high rainfall intensity. Non-point sources of these types of pollutants have less effect on groundwater in this segment than most others in the LCRB due to less karst topography in the segment.

Waste Load Allocations and Priority

Computer modeling for segment 1 showed that existing water quality on the main stem of the Cumberland River is good and no D.O. deficit exists in the main stem of the segment. The existing quality on McCormick Creek is poor due to Q7-10 low-flow equal to zero. The 1980 and 1995 stream-flow modeling shows that by adding tertiary treatment capable of 95% removal of BOD, SS, and NH_3. Smithland sewage treatment plant and Smithland Elementary School would not violate the stream D.O. standards or the ammonia toxicity levels required. Exhibit B-1.4t shows the waste load allocations proposed for 1980.

Exhibit B-1.3t: Existing Discharge Characteristics (1975)

Code No.	Facility	Location	NPDES Permit No.	Treatment Type	Q7-10 (cfs)	Discharge Characteristics (mg/1)				
						Flow (mgd)	BOD	SS	NH_3	Other
02001	Smithland STP	McCormick Cr.-3.8/1.0/0.6	KY0025836	Lagoon	0	.0324	40	100	1	--
02002	Smithland Elem. School	McCormick Cr.-3.8/1.5/0.2	---	Settling Tank w/ Sand Filter	0	.0028	40	100	1	--
02102	Industrial Minerals Co., Inc.	McCormick Cr.	KY0024171	Lagoon	0	N/A	N/A	N/A	N/A	--

Exhibit B-1.4t: Waste Load Allocations (1980)

Code No.	Facility	Max. Daily Waste Load lb/day	Proposed Effluent Characteristics/Load Reduction						Priority
			Flow (mgd)	BOD (mg/1)	SS (mg/1)	NH_3 (mg/1)	DO (mg/1)	Other	
02001	Smithland STP	11.67	.0380	10/95%	10/95%	1.0/96%	8.0	-	153.9
02002	Smithland Elem. School	0.47	.0030	10/95%	10/95%	1.0/96%	8.0	-	-
02102	Industrial Minerals Co. Inc.	-	N/A	N/A	55	N/A	N/A	-	-

LOWER CUMBERLAND RIVER BASIN

EXHIBIT B-1.1m 1 Thru 4

SEGMENT MAP

LEGEND

DISCHARGERS

- M 00 — **MAJOR (OVER 1.0 MGD)**
- D 00 — **PRINCIPAL (LESS THAN 1.0 MGD)**
- **(M) MUNICIPAL DISCHARGERS**
- **(D) DOMESTIC DISCHARGER**
- ▲ **MINING RELATED**

5 4 3 2 1 0 5

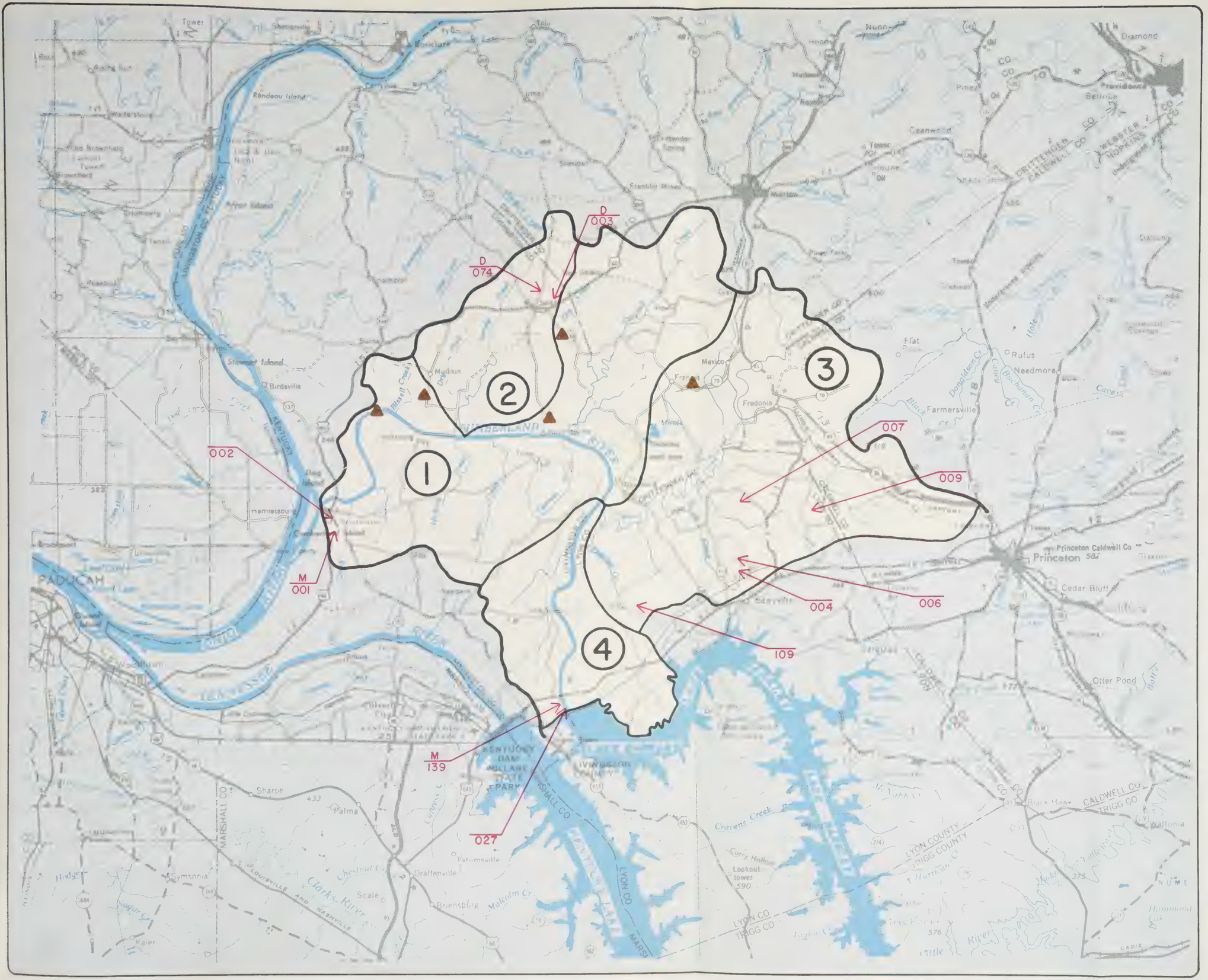
GRAPHIC SCALE IN MILES

Base Data: U. S. Geological Survey

KENTUCKY WATER QUALITY MANAGEMENT PLAN

Prepared for Division of Water Quality
KENTUCKY DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION

G. REYNOLDS WATKINS CONSULTING ENGINEERS, INC.
Lexington, Bowling Green & Louisville, Kentucky



LOWER CUMBERLAND RIVER BASIN

EXHIBIT B-1.1m 1 Thru 4

SEGMENT MAP

LEGEND

DISCHARGERS

- M 00 — **MAJOR (OVER 1.0 MGD)**
- D 00 — **PRINCIPAL (LESS THAN 1.0 MGD)**
  - **(M) MUNICIPAL DISCHARGERS**
  - **(D) DOMESTIC DISCHARGER**
- ▲ **MINING RELATED**

5 4 3 2 1 0 5

GRAPHIC SCALE IN MILES

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Total maximum daily loads for segment 1 are simply an addition of the individual discharge daily loads presented in Exhibit B-1.4t. This maximum daily waste load allocation applies only to McCormick Creek in this case since it is a Water Quality Limited sub-reach of an Effluent Limited segment.

Segment 1 total maximum daily waste load allowable for projected 1980 flows is therefore 12.14 lbs BOD/day based on existing dischargers.

Municipal Needs (1980 and 1995)

To comply with P.L. 92-500, the community of Smithland will be required to install secondary treatment by 1977. Unless unusual population growth occurs, either due to industry or annexation, Smithland will not appreciably increase in size in the next twenty years. The treatment system installed should plan for any future growth areas where domestic or industrial development is expected. The projected needs for Smithland as shown in Exhibit B-1.5t include the installation of a 50,000 gpd package extended aeration plant with the effluent pumped and discharged into the Cumberland River. This configuration would allow Smithland to discharge T1A treatment rather than T4B which is required for McCormick Creek. Total cost for the system would be $186,000. This includes $110,000 for the treatment facilities and $76,000 for pump station and force main. No new interceptors or collectors are projected needed since population is only expected to increase to 380 in 1995.

Exhibit B-1.5t: Municipal Needs

Code Number	Facility	1980/1995 Treatment Needs	Costs Million $	Compliance Goals
02001	SMITH-LAND STP	T1A/T1A	0.110	6-30-1977
	Priority 153.9	P	0.076	

P - Pumping to Cumberland River

Alternative Water Quality Management Plans

The Smithland sewage system could be expanded to serve Smithland Elementary School thus alleviating the need for the school to install a small extended aeration package plant to meet stream standards for McCormick Creek. The cost of each alternate should be considered in greater detail in the 201 Facilities Plan for the Smithland-Ledbetter area.

To provide T4B treatment required for meeting the standards on McCormick Creek would require an extended aeration plant with mixed media filtration and chlorination. Sludge drying beds would also need to be provided with land spreading for sludge disposal. Total estimated 1975 cost for this treatment would be $228,000. This is only $3,000 more than the pumping alternate when operating costs for pumping are considered. Considering the lack of dilution in McCormick Creek and the inability of any treatment type (even T4B) to guarantee the expected efficiency, the pumping alternate rates higher than the installation of tertiary treatment. These alternates should be carefully studied during preparation of the 201 facilities plans.

A detailed study should be conducted to determine the actual treatment needs to meet the proposed 1977 secondary standards. Lagoon systems are capable of discharging an effluent BOD_5 of 30 mg/l and with filtration could meet the SS concentration of 30 mg/l. The tertiary proposed treatment to meet the 1980 standards for McCormick Creek seems somewhat harsh to the 320 residents of Smithland. The goal of meeting the stream D. O. standards in a stream with no commercial or recreational value should be investigated in depth to determine needed changes.

SEGMENT #2 ANALYSIS

Classification: Water Quality Limited

Priority: 2.46

Location

As shown by Exhibit B-1.1m, Segment Basin #2 is located in Livingston and Crittenden Counties. All but 8 percent of the total 38.4 square miles of surface area is located in Livingston County. Federal route 60 bisects the small segment east and west. Salem is the largest populated area (pop. 480) within the segment basin.

Basic Planning Data

Segment #2 is projected to add 178 persons, and 91 housing units between 1970 and 1995 (see Exh. B-2.1t). No new employment opportunities are projected within the segment basin. Population density is expected to increase from 21 persons per square mile in 1970 to 23 persons per square mile in 1995. Urban-related land use, as reflected by rural non-farm population growth, is projected to increase from 0.06 square miles to 0.09 square miles by 1995.

Exh. B-2.1t: Segment #2 Basic Planning Data*

	1970	1975	1980	1995
Population Total	810	836	862	988
..Rural	810	836	862	988
..Farm	600	600	601	694
..Non-Farm	210	236	261	294
..Urban	0	0	0	0
Population Density ..Persons/sq.mi.	21.09	21.77	22.44	25.73
Housing Units	282	302	325	373
..Rural	282	302	325	373
..Urban	0	0	0	0
Non-Ag. Employment	-	-	-	-
..Manufacturing	-	-	-	-
..Non-Manufacturing	-	-	-	-
Land Use Total (sq.mi.)	38.40	38.40	38.40	38.40
..Rural	38.34	38.33	38.32	38.31
..Agriculture	35.96	35.95	35.94	35.93
..Silviculture	2.38	2.38	2.38	2.38
..Mining	.00	.00	.00	.00
..Construction	.00	-	-	-
..Urban-Related	.06	.07	.08	.09

*for additional information on basic planning data, see Appendix "A".

Segment Hydrology

Segment #2 is drained by Sandy Creek as its main stem with several smaller branch tributaries. Sandy Creek enters the Cumberland River at M.P. 12.80 and drains an area of approximately 38 square miles in Livingston and Crittenden Counties. Q7-10 for Sandy Creek has been estimated at 0 cfs throughout its reach. Average daily stream flows were not available in any part of Segment #2. Part of this area has karst topography with underground solution channels. Of particular interest is the area southeast of James Lake. The KDNREP State Continuing Plan, FY 1974, indirectly indicates that Cox Spring Branch in this area, flows underground to Sandy Creek. Investigation of the Dycusburg, Kentucky 7.5 minute quadrangle map, published by USGS in 1954, indicates that Cox Spring Branch and Dry Creek could, and probably do, run underground to Puckett Spring on the Livingston-Crittenden County line in Segment #1. For purposes of consistency with the State Plan, the flow from Cox Spring Branch and Dry Creek has been included in Segment #2 and a theoretical route of travel for computer modeling laid out in this segment.

Water Quality Data

No water quality monitoring stations are located in Segment #2. Water quality, as estimated by the computer run for 1975 in-stream water quality, is poor enough to warrant a Water Quality Limitation classification due to a D.O. deficit in Sandy Creek, the main stem of the segment caused by discharges from Salem Community Hospital and Salem Nursing Home.

No recorded data for significant in-stream pollution is available for this segment. Groundwater quality for most of this segment is thought to be good, but the Salem area, with its localized community served by septic tanks and drain fields, cesspools and pit toilets, has poor quality groundwater. The well-water system previously serving this community was becoming polluted from the septic field influences.

Point Source Discharges

Only three point sources have been identified in Segment #2 as shown by Exhibit B-2.3t. A brief discussion of each follows.

Salem Nursing Home discharges approximately 6000 gpd to an unnamed tributary of Cox Spring Branch, north of Salem, Kentucky. The home uses an extended aeration factory built plant capable of producing 15 mg/l BOD_5, 20 mg/l SS, and 2 mg/l NH_3 Nitrogen.

Salem Community Hospital discharges approximately 6000 gpd to Cox Spring Branch from a small extended aeration plant similar to that used by Salem Nursing Home.

Eagle Picher Industries has applied for a permit

Exhibit B-2.2t: Existing Discharge Characteristics (1975)

Code No.	Facility	Location	NPDES Permit No.	Treatment Type	Q7-10 (cfs)	Discharge Characteristics (mg/l) Flow (mgd)	BOD	SS	NH_3	Other
02074	Salem Nursing Home	Cox Spring Br.-Sandy Creek - 12.8/3.2/0.5/4.0/1.25/1.80	KY0024911	Extended Aeration (E.A.)	0	.0060	15	20	2	--
02003	Salem Community Hospital	Cox Spring Br.-Sandy Creek - 12.8/3.2/0.5/4.0/2.5	---	E.A.	0	.0060	15	20	2	--
02103	Eagle Picher Industries	Cox Spring - Sandy Creek	---	Lagoon	0	N/A	N/A	55	N/A	--

Exhibit B-2.3t: Waste Load Allocations (1980)

Code No.	Facility	Max. Daily Waste Load lb/day	Proposed Effluent Characteristics/Load Reduction Flow (mgd)	BOD (mg/l)	SS (mg/l)	NH_3 (mg/l)	DO (mg/l)	Other	Priority
02074	Salem Nursing Home	1.0	.0060	10/95%	10/95%	1.0/96%	8.0	-	-
02003	Salem Community Hospital	1.0	.0060	10/95%	10/95%	1.0/96%	8.0	-	-
02103	Eagle Picher Industries	N/A	N/A	N/A	55	N/A	N/A	-	-

to discharge waste from a zinc mine and milling operation near Salem, Kentucky.

Non-Point Source Discharges

Segment #2, much like Segment #1, has several areas suitable for mining with old mines throughout the northern part of the segment. The area has been heavily prospected and has potential for mine development if the economy should permit. No known water quality problems exist due to the mines in Segment #2.

The rural population is generally served by septic field installations. The absence of any large communities indicates this may not be a grave problem. The karst topography of this area, however, lends itself well to the contamination of groundwater through solution channels. Drinking water from wells should be regularly tested for coliform and other impurities.

Some non-point pollution of stream water and groundwater occurs in this segment from agricultural runoff. In periods of heavy rainfall, silt, fertilizer, pesticides and animal wastes are washed into the streams and sinkholes. Some siltation of streams may also be caused by silviculture (forestry) operations in this segment, but no records of severe pollution from either agricultural or silvilcultural operations have been found for this segment.

Waste Load Allocations and Priority

The 1980 computer model estimates give the treatment needs for Segment #2, as shown in Exhibit B-2.3t. By discharging into a zero Q7-10 flow stream which runs underground, extreme care must be exercised to insure that groundwater sources are not contaminated. Waste load allocations for Salem Nursing Home and Salem Community Hospital have been established assuming a treatment level, as shown in the above exhibit. Since the volume of discharge is small, the segment priority is low (2.46).

Municipal Needs

No municipality having central sewage collection and treatment facilities currently discharges in Segment #2, but Salem, a 201 Designated Planning Area, may in the near future be constructing central facilities. The 201 Plan being prepared by Florence and Hutcheson Engineers should be reviewed in draft form for incorporation into this continuing plan. Proposed facility locations and treatment levels should be computer model for adequate treatment requirements and with that some means could be determined by KDNREP for computing the facility priority for Salem.

SEGMENT #3 ANALYSIS

Classification: Water Quality Limited

Priority: 12.65

Location

As shown in Exhibit B-1.1m, Segment Basin #3 is located in Lyon, Crittenden, and Caldwell Counties. The segment consist of 101.4 square miles of land with 42 percent of this surface area in Lyon County, 36 percent in Crittenden, and the remaining 22 percent in Caldwell. Populated areas within the county include the north portion of the city of Eddyville (pop. 1,981) in Crittenden County and Fredonia (pop. 450) in Caldwell County.

Basic Planning Data

Segment #3 is projected to add 670 persons between 1970 and 1995 (see Exh. B-3.1t). This increased population, plus other housing needs, will require 378 new housing units by 1995. No new employment opportunities are projected within the segment basin. Population density is expected to increase from 28 persons per square mile in 1970 to 34 persons per square mile in 1995. Urban-related land use, in the 25 year period, is projected to increase by 0.14 square miles.

Exh. B-3.1t: Segment #3 Basic Planning Data*[1]

	1970	1975	1980	1995
Population Total	2,834	2,912	3,014	3,504
..Rural	2,834	2,912	3,014	3,504
..Farm	735	752	778	900
..Non-Farm	2,099	2,160	2,236	2,604
..Urban	0	0	0	0
Population Density ..Persons/sq.mi.	28.00	28.72	29.72	34.91
Housing Units	890	965	1,063	1,268
..Rural	890	965	1,063	1,268
..Urban	0	0	0	0
Non-Ag. Employment	-	-	-	-
..Manufacturing	-	-	-	-
..Non-Manufacturing	-	-	-	-
Land Use Total (sq.mi.)	101.40	101.40	101.40	101.40
..Rural	100.81	100.79	100.77	100.67
..Agriculture	98.91	98.89	98.87	98.77
..Silviculture	1.90	1.90	1.90	1.90
..Mining	.00	.00	.00	.00
..Construction	.00	-	-	-
..Urban-Related	.59	.61	.63	.73

*[1]-for additional information on basic planning data, see Appendix "A".

Segment Hydrology

Segment #3, as shown in Exhibit B-1.1m, includes Livingston Creek and its tributaries from the Cumberland River confluence to the headwaters. The main streams in this segment are Panther Creek, Spring Creek, Crab Creek, Caldwell Spring Creek, Skinframe Creek, and Dry Fork, served by smaller tributaries. Q7-10 values for the main stream, Livingston Creek, are zero as well as for all the tributaries. Several small bodies of water lie within Segment #3, including Maple Lake, a small lake near the State Penal Farm, an impoundment at the headwaters of Dry Fork of Skinframe Creek, and many small ponds formed by sinkholes. The karst topography of this area encourages groundwater flow through the soluable limestone. Draining an area of 101 square miles in Crittenden, Caldwell, and Lyon Counties, this segment serves a rural population of 2912.

Water Quality Data

Several monitoring sites were recorded in the EPA STORET system giving water quality of a very few grab samples. Not enough data was available to estimate average stream flow. These monitor stations (7, 8, 9, 10 on Exhibit A-1.1t) are on McElroy Creek, a tributary to Skinframe Creek; Livingston Creek, above and below Dry Fork; and one station near Dycusburg. Data from these stations show pH values range between 7 and 8 and water hardness ranges between 200 and 350 ppm. The segment is classified WQL because of discharges from feed lots, one mine, and the Kentucky State Penal Farm. A D.O. deficit occurs from M.P. 2.7 to M.P. 11.4 on Livingston Creek and also on Panther Creek and Crab Creek.

Point Source Discharges

Six point source discharges, as listed in Exhibit B-3.2t, have been identified in Segment #3. Four are hog feeding lots, one is a sanitary discharge from a mining operation, and one is the Kentucky State Penal Farm. A short discussion of each follows.

Herrings Hog Parlor discharges from a nonaerated lagoon to Crab Creek. Maximum discharged flow is 2200 gpd with a heavy BOD and SS loading. Higgings Hog Parlor and Millikan Hog Parlor have similar flows and also discharge to Crab Creek. Bennett Hog Parlor, having similar treatment as the above facilities, discharges to Skinframe Creek.

The Minerva Oil Company has an NPDES permit to discharge waste containing SS, Iron, Flouride, and sanitary sewage from a mine location one mile east of Frances, Kentucky. Employing a recycle sedimentation system, the mine discharge flows into Dry Creek in an

area which has been heavily mined and prospected in the past.

The Kentucky State Penal Farm discharges 2200 gpd of sewage waste into a sinkhole. The extended aeration plant employed does not produce an effluent acceptable by the 1980 proposed standards as shown by Exhibit B-3.5t. It has been assumed that this waste flows underground and emerges within the Skinframe Creek drainage system.

Non-Point Source Discharges

The two communities within Segment #3, Fredonia and Frances, both depend upon septic field disposal of wastes. No complaints of contamination of drinking water have yet been heard, but these concentrated areas of septic field sewage disposal have high potential for groundwater pollution. Fredonia receives potable water from Eddyville while Frances depends on groundwater supplies for its domestic use and must be monitored closely for groundwater pollution.

The area immediately surrounding Frances is heavily mined and prospected for flourite. Acid conditions or high Flouride concentrations could result from untreated mine washings, however, the problem is not considered significant at this time.

Some non-point pollution of stream and groundwater occurs in this segment from agricultural fertilizer, pesticides, and siltation during periods of heavy rainfall. Some siltation may also come from forestry operations, but no significant pollution from either of the sources has been brought to our attention.

Waste Load Allocations and Priority

Only Herring's, Bennett's and the Kentucky State Prison Farm contribute to the maximum daily waste load by discharging directly into a stream. The other dischargers have a lagoon system from which the effluent exfiltrates, much like a sand filter. The total waste load excluding these plants, is 1.33 lbs. BOD/day. The segment priority, which includes the effect of these nondischarging point sources, was calculated as 12.65. Waste load allocations based on the zero Q7-10 flows in the receiving streams were computed by the computer stream model for each of these discharges and are listed in Exhibit B-3.3t. These waste load allocations represent the allowable loads based on 1980 projected flows and T4B level of treatment which is required to maintain stream water quality levels of Dissolved Oxygen equal to 5 mg/l and to keep from exceeding toxic NH_3 concentrations of 4 mg/l.

Municipal Needs

The community of Fredonia will, in the future, need some means for sewage disposal. Presently, they buy water from Eddyville and the approximately 500 residents now depend upon septic tank installations. Facility needs and priority determination for Fredonia must await 201 Planning Area Designation and proper evaluation of proposed treatment and receiving stream modeling for the waste effluent. This plan determines municipal needs only for those municipalities currently treating community wastes at a central plant.

Alternative Water Quality Management Plans

The proposed effluent characteristics for point discharges in this segment as listed in Exhibit B-3.3t, should be given careful consideration before implementing them in NPDES*[1] permits. These proposed

*[1]-National Pollutant Discharge Elimination System

Exhibit B-3.2t: Existing Discharge Characteristics (1975)

Code No.	Facility	Location	NPDES Permit No.	Treatment Type	Q7-10 (cfs)	Discharge Characteristics (mg/l)				
						Flow (mgd)	BOD	SS	NH_3	Other
02004	Herrings Hog Parlor	Crab Creek - Livingston Cr. 20.6/7.0/6.1/ 0.4	---	Lagoon	0	.0022	40	100	1	--
02005	Higging Hog Parlor	Crab Creek - Livingston Cr. 20.6/7.0/4.3/ 0.2	---	Lagoon	0	.0022	40	100	1	--
02006	Millikan Hog Parlor	Crab Creek - Livingston Cr. 20.6/7.0/8.6	--- ---	Lagoon	0	.0022	40	100	1	--
02007	Bennett Hog Parlor	Skinframe Cr. 20.6/11.7/2.6/ 0.8	---	Lagoon	0	.0022	40	100	1	--
02075	Minerva Oil	Dry Fork Creek 20.6/11.7/6.6	KY0021423	Recycle w/ Sedimentation	0	N/A	15	20	2	--
03009	Ky. State Prison Farm	Skinframe Cr. 20.6/1.0/0.2/ 11.7	---		0	.0020	15	20	2	--

effluent characteristics are those required for any discharge of domestic sewage effluent to meet stream water quality standards for Q7-10 zero flow streams. These are tertiary treatment levels and would pose severe hardship on most small dischargers compelled to upgrade their package plants or lagoons to tertiary treatment levels. Perhaps the logical solution is that any discharges under 50,000 gallons per day or some such reasonable discharge would be required only to have secondary treatment.

Exhibit B-3.3t: Waste Load Allocations (1980)

Code No.	Facility	Max. Daily Waste Load lb/day	Proposed Effluent Characteristics/Load Reduction						Priority
			Flow (mgd)	BOD (mg/l)	SS (mg/l)	NH_3 (mg/l)	DO (mg/l)	Other	
02004	Herrings Hog Parlor	0.33	.0022	10/95%	10/96%	1.0/96%	8.0	-	-
02005	Higging Hog Parlor	-	.0022	10/95%	10/96%	1/96%	8.0	-	-
02006	Millikan Hog Parlor	-	.0022	10/95%	10/96%	1/96%	8.0	-	-
02007	Bennett Hog Parlor	0.50	.0022	10/95%	10/96%	1.0/96%	8.0	-	-
02075	Minerva Oil	-	N/A	10/95%	10/96%	1/96%	8.0	-	-
02009	Kentucky State Prison Farm	0.50	.003	10/95%	10/96%	1.0/96%	8.0	-	-

SEGMENT #4 ANALYSIS

Classification: Effluent Limited Priority: 12.24

Location

As shown in Exhibit B-1.1m, Segment Basin #4 is located in Livingston and Lyon Counties. The segment consists of 43 square miles which is bisected by the Cumberland River. There are no large concentrations of population in segment #4. The southern portion of the segment, adjacent to Lake Barkley, is characterized by strip development with motels, restaurants and boat ramps.

Basic Planning Data

Segment #4 is projected to add 369 persons, and 184 housing units, between 1970 and 1995 (see Exh. B-4.1t). No new employment opportunities are projected within the segment basin. Population density is expected to increase from 33 persons per square mile in 1970 to 42 persons per square mile in 1995. During the same time period, urban-related land use is expected to increase by 0.06 square miles.

Exh. B-4.1t: Segment #4 Basic Planning Data*[1]

	1970	1975	1980	1995
Population Total	1,441	1,486	1,545	1,810
..Rural	1,441	1,486	1,545	1,810
..Farm	603	622	645	749
..Non-Farm	838	864	900	1,061
..Urban	0	0	0	0
Population Density ..Persons/sq.mi.	33.51	34.56	36.00	42.10
Housing Units	452	492	543	636
..Rural	452	492	543	636
..Urban	0	0	0	0
Non-Ag. Employment	-	-	-	-
..Manufacturing	-	-	-	-
..Non-Manufacturing	-	-	-	-
Land Use Total (sq.mi.)	43.00	43.00	43.00	43.00
..Rural	42.76	42.76	42.75	42.70
..Agriculture	40.23	40.23	40.22	40.17
..Silviculture	2.38	2.38	2.38	2.38
..Mining	.15	.15	.15	.15
..Construction	-	-	-	-
..Urban-Related	.24	.24	.25	.30

*[1]-for additional information on basic planning data, see Appendix "A".

Segment Hydrology

Segment #4 includes the Cumberland River from its confluence with Livingston Creek to Barkley Dam. Minor tributaries include Richland Creek, Baldwin Slough, Big Crevasse Creek, Cook Creek, and Flat Creek. Flow augmentation from Lake Barkley keeps Q7-10 low-flows in the Cumberland equal to 5087 cfs. Q7-10 on all the tributaries is equal to zero. The relatively flat topography along the river encourages ponding on the west side. The eastern part of segment 4 adjoins segments 3, 5, and 7, is fairly hilly and heavily wooded.

Water Quality Data

Stations located on Lake Barkley at M.P.80 in Tennessee and at the Barkley Canal indicate the water quality to be very good flowing into this segment. No data was available within segment 4 itself. The computer model for this stream segment indicates that even with existing dischargers, the dissolved oxygen content of the stream does not fall below 5.0 mg/1. On this basis, the segment was classified Effluent Limited.

Point Source Discharges

Segment 4 has three permitted dischargers as shown in Exhibit B-4.2t Reed Crushed Stone Company, operating a quarry northeast of Lake City, discharges water containing suspended solids to an unnamed intermittant stream flowing to the Cumberland River. The Barkley Dam Project discharges up to 1,200 gpd from a settling tank and sand filter facility directly into the lower Cumberland River below Barkley Dam. Lake City Sewage Treatment Plant treats the effluent from Lake City and Grand Rivers in a 300,000 gpd extended aeration plant. The plant discharges 60,000 gpd to the Cumberland River at approximately M.P. 30 on the river.

Non-Point Source Discharges

There is some ground water pollution from the scattered rural population served primarily by septic tanks and drain fields, and the Clyde Reed Sand and Gravel Pits near Lake City.

The septic fields pose little ground water problems since the only population concentrations are Lake City and Grand Rivers who are served by a treatment plant. Sparse residential building has progressed along US 62 with no areas of major concern.

The Reed Quarry Pits pose only potential sediment problems with no adverse acidity or toxic metals concentrations. Some agricultural and silvicultural non-point sources of pollution occur in this segment releasing silt, fertilizer, pesticides and animal waste to surface and ground waters primarily during periods of high-intensity rainfall.

Municipal Needs

Presently, the NPDES permit for Lake City calls for 40 mg/1 BOD_5 and 40 mg/1 SS. In order to meet the 1977 requirements for D.O. and SS from P.L. 92-500, the effluent limits need to be 30 mg/1 BOD_5 and 30 mg/1 SS. This effluent level can probably be produced by efficient operation of the present plant. Presently, the plant is discharging approximately 60,000 gpd with a capacity of 300,000 gpd. This plant should serve the needs of the Lake City-

Grand Rivers communities for several years barring excessive permanent residential growth in the area.

Estimated needs as for the Lake City area include infiltration-inflow corrective measures, interceptor needs projected for 1995, and collector needs projected for 1980. A 1975-1980 population growth of 30 people in this area will require 1290 feet of new collectors at a cost of $30,934. Interceptor needs for 1995 were estimated at 2000 feet, a capital cost of $65,400. The existing plant presently meets the secondary treatment standards required for the Cumberland River and will need no major expansions or additions in the projected future.

The discharge priority for Lake City STP is 19.58 calculated from the needs shown in Exhibit 4.4t.

Exhibit 4.4t: Municipal Needs

Code Number	Facility	1980/1995 Treatment Needs	Cost Million	Compliance Goals
02139	Lake City STP	T1A/T1A	-	7/1/77
		C	0.031	
		I	0.065	
		I/I	0.077	

Waste Load Allocations and Priority

Since this is an Effluent Limited segment, it has a low priority of 12.24. The maximum daily waste load for the recommended level of treatment at the predicted 1980 flow rate would be as shown in Exhibit 4.3t. This value should only be considered as the effluent load to the stream and not an allocation since segment 4 is Effluent Limited.

Alternative Water Quality Management Plans

The Grand Rivers-Lake City area has been designated as a 201 planning area by the Kentucky Department for Natural Resources. When the 201 Facilities Plan is prepared, a more detailed needs study and cost analysis will be presented.

Exhibit B-4.2t: Existing Discharge Characteristics (1975)

Code No.	Facility	Location	NPDES Permit No.	Treatment Type	Q7-10 (cfs)	Discharge Characteristics (mg/l)				
						Flow (mgd)	BOD	SS	NH_3	Other
02027	Barkley Dam Project	Cumberland River M.P. 30.6	---	Settling Tank w/ Sand Filter	5087	.0012	40	100	1	--
02110	Reed Crushed Stone	Cumberland River	KY0024015	Lagoon	5087	N/A	N/A	55	N/A	--
02139	Lake City STP	Cumberland River M.P. 30.5	KY0027227	Contact Stabilization	5087	.060	40	40	2	--

Exhibit B-4.3t: Waste Load Allocations (1980)

Code No.	Facility	Max. Daily Waste Load lb/day	Proposed Effluent Characteristics/Load Reduction						Priority
			Flow (mgd)	BOD (mg/l)	SS (mg/l)	NH_3 (mg/l)	DO (mg/l)	Other	
02027	Barkley Dam Project	1.20	.0012	30/85%	30/87%	20/20%	4.0	-	-
02110	Reed Crushed Stone	N/A	N/A	N/A	55	N/A	N/A	-	-
02139	Lake City STP	70.06	.070	30/85%	30/87%	20/20%	4.0	-	19.6

SEGMENT #5 ANALYSIS

Classification: Effluent Limited Priority: 11.08

Location

As shown in Exhibit B-5.1m, Segment Basin #5 is located in Lyon, Trigg, Caldwell, and Livingston Counties. The largest segment basin in the Lower Cumberland, Segment #5 contains 354.6 square miles of surface area. Lyon and Trigg Counties share 39 percent and 54 percent, respectively. The basin has wide use as a natural park, recreation and resort area, agricultural community, and military reservation. Lake Barkley and part of the Land Between The Lakes is located in this basin.

Basic Planning Data

Segment #5 is projected to add 667 persons, and 368 housing units, between 1970 and 1995 (see Exh. B-5.2t). No new employment opportunities are projected within the segment basin. Population density is expected to increase from 10 persons per square mile in 1970 to 12 persons per square mile in 1995. During this same time period, urban-related land use (as reflected by rural non-farm population growth) is expected to increase by 0.11 square miles.

Exh. B-5.2t: Segment #5 Basic Planning Data*[1]

	1970	1975	1980	1995
Population Total	3,826	3,940	3,994	4,493
..Rural	3,826	3,940	3,994	4,493
..Farm	1,264	1,303	1,321	1,520
..Non-Farm	2,562	2,637	2,673	2,973
..Urban	0	0	0	0
Population Density ..Persons/sq.mi.	10.79	11.11	11.26	12.67
Housing Units	1,188	1,276	1,359	1,556
..Rural	1,188	1,276	1,359	1,556
..Urban	0	0	0	0
Non-Ag. Employment	-	-	-	-
..Manufacturing	-	-	-	-
..Non-Manufacturing	-	-	-	-
Land Use Total (sq.mi.)	354.60	354.60	354.60	354.60
..Rural	353.88	353.87	353.86	353.77
..Agriculture	188.88	188.87	188.86	188.77
..Silviculture	164.53	164.53	164.53	164.53
..Mining	.47	.47	.47	.47
..Construction	-	-	-	-
..Urban Related	.72	.73	.74	.83

*[1]-for additional information on basic planning data, see Appendix "A".

Segment Hydrology

Segment #5, as shown by Exhibit B-5.1m, drains 354.6 square miles of the LCRB, encompassing most of Lyon County and the western portion of Trigg County, including most of the Land Between The Lakes. The main stem of this segment is the Lower Cumberland River impoundment forming Barkley Lake from M.P. 30.6 at Barkley Dam to M.P. 74.7 at the Kentucky-Tennessee State line. The segment boundaries include all small tributaries of Lake Barkley up to their headwaters between the milepoints mentioned above. Very little of this area contains karst topography and ranges from moderate to steep slopes. Q7-10 low flow at Barkley Dam is 5087 cfs, while all of the small tributaries to the lake have Q7-10 low flows. Q7-10 low flow at the confluence of Little River with Lake Barkley is estimated at 25 cfs.

Water Quality Data

There is more water quality data available for this segment than any other in the LCRB. A permanent flow gauging station is located on the Kentucky Lake-Lake Barkley interconnecting canal and the KDNREP is installing and monitoring three water quality stations on Lake Barkley as follows: a primary station at milepoint 58.2 and a primary station at milepoint 70. Much data on the impoundment water quality has been obtained from the EPA STORET data center. This STORET data has been most helpful in judging the quality of water in Lake Barkley. The waters of Lake Barkley are shown by this data to be high in oxygen year-round and to contain on the average no severe concentrations of toxic or eutrophying elements. Total dissolved Phosphorous in Lake Barkley ranges from .02 to .06 mg/l as shown by the available STORET data. These dissolved Phosphorous levels are somewhat higher than the .025 mg/l limit recommended by memo from Region IV EPA to prevent eutrophication*[2] of impoundments. These Phosphorous levels are not felt to be excessive without substantial evidence to the contrary and are not thought to be reduced significantly by Phosphorous removal at point source discharges. Existing water quality data available shows this range of dissolved Phosphorous present in all of the Cumberland River Basin, even upstream of any domestic wastes in some cases, inplying that it is a background Phosphorous level.

The high quality of water in this main stem of Segment #5, Lake Barkley, warrants an Effluent Limited classification for this segment.

Groundwater quality in this segment is assumed to be good except for isolated areas where septic tanks and drain fields influence local groundwater quality.

Point Source Discharges

There are 20 recorded point source discharges in this segment, 14 of which discharge directly into Lake Barkley. These discharges and their existing

*[2]-Wagner, Paul L., "A Simple Model to Determine Nutrient Concentrations in Lakes.", 1974

characteristics are listed in Exhibit B-5.3t. As shown by this exhibit, most of these discharges are campsites, resort areas or homes served by extended aeration factory-built sewage treatment plants which provide secondary waste treatment. There are no municipalities discharging into this segment. The largest of the point discharges is Kentucky State Penitentiary discharging 330,000 gpd directly into the lake. Only 7 of these discharges have flows greater than 5000 gpd and only 3 with flows greater than 10,000 gpd.

Non-Point Source Discharges

No major non-point sources of pollution discharge in this segment. There are some unsewered communities served by septic tanks and drain fields which contribute to localized groundwater pollution, but no serious ground water problems are reported in this segment.

Some non-point pollution is dumped into Lake Barkley by agricultural and silvicultural (forestry) operations. Silt, fertilizers, pesticides, and animal wastes wash into the lake during heavy rainfall, but groundwater effects from the wastes are minimized due to the steep topography allowing rapid runoff.

The overall effect of these non-point sources of pollution is not considered severe in this segment.

Waste Load Allocations and Priority

Waste load allocations were not calculated for this segment since it is Effluent Limited, but proposed effluent limitations as determined by the 1980 computer model to prevent stream water quality violations are listed in Exhibit B-5.4t. All discharges flowing directly into Lake Barkley with flows of 5000 gpd or less have proposed secondary effluent levels as required by P.L. 92-500, but larger discharges have proposed T4B treatment levels for lake discharges. Discharges into the tributaries of the lake have the proposed effluent levels as set by the computer model for 1980 flows, and require T4B treatment levels wherever they discharge into zero Q7-10 low flow streams.

Alternative Water Quality Management Plans

Serious thought should be given to the small dischargers on zero Q7-10 low flow streams tributary to Lake Barkley before requiring them by NPDES permits to meet T4B levels of treatment. This proposed treatment level, based on the computer modeling, bases the estimated stream water quality on a very nebulous Q7-10 low flow value which in most cases has no record of flow to substantiate it. A sophisticated monitoring and statistical determination of most probable Q7-10 flows should be made in this segment for all its tributaries receiving treated sewage effluent or proposed to receive same. It would be impractical to require T4B treatment levels where in reality they may not be needed due to lack of sufficient recorded data.

Also, discharges to tributaries at short distances from their confluence with Lake Barkley should be considered for secondary treatment requirements unless stream water violations are shown to be caused in these inlets and sloughs due to the secondary effluents.

LOWER CUMBERLAND
RIVER BASIN

EXHIBIT B-5.1m 5 Thru 10

SEGMENT MAP

LEGEND

DISCHARGERS

- M / 00 — MAJOR (OVER 1.0 MGD)
- M / 00 — PRINCIPAL (LESS THAN 1.0 MGD)
- (M) MUNICIPAL DISCHARGERS
- (D) DOMESTIC DISCHARGERS
- (I) INDUSTRIAL DISCHARGERS
- SW — SOLID WASTE
- MINING RELATED

5 4 3 2 1 0 5

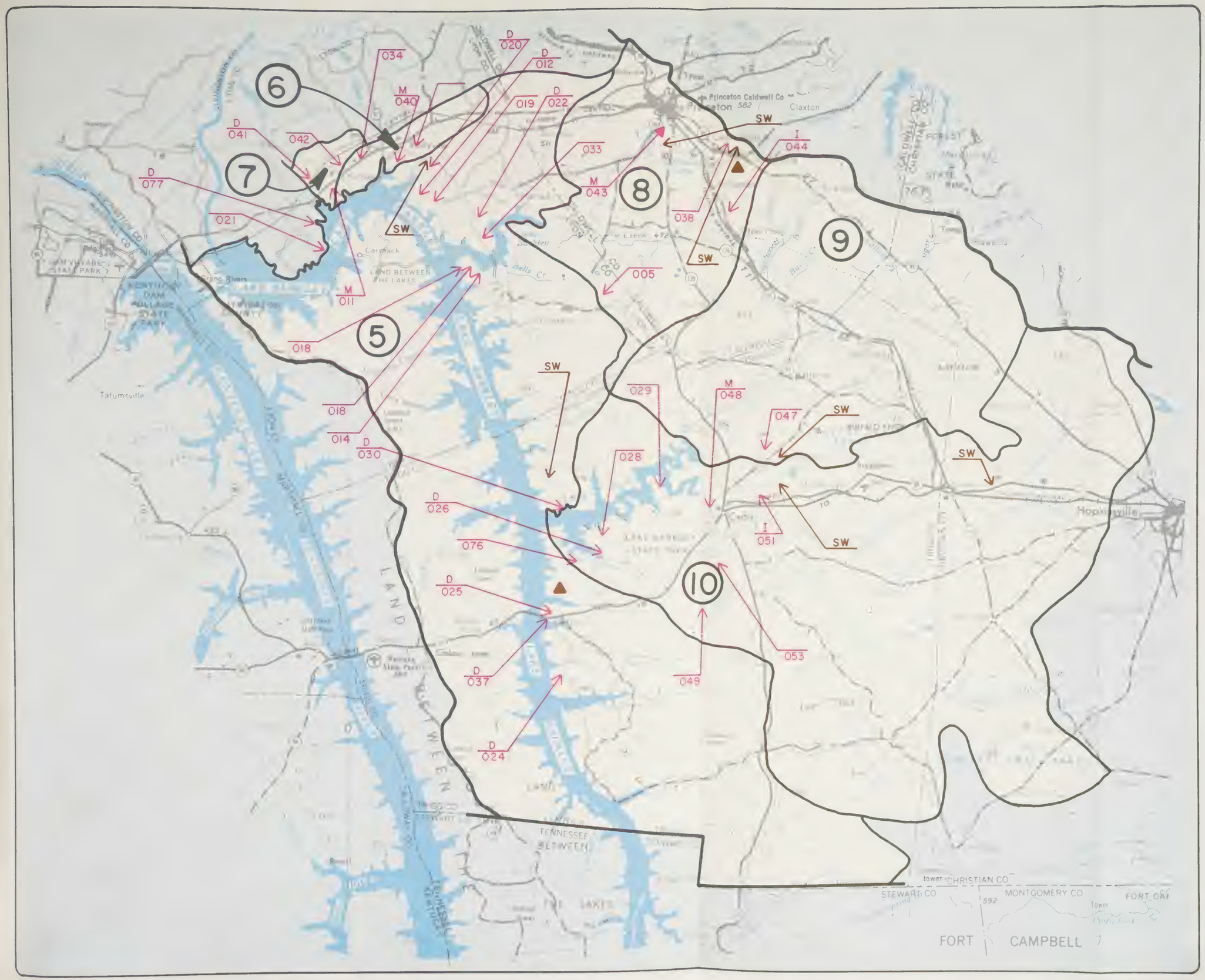
GRAPHIC SCALE IN MILES

Base Data: U. S. Geological Survey

KENTUCKY WATER QUALITY MANAGEMENT PLAN

Prepared for Division of Water Quality
KENTUCKY DEPARTMENT FOR NATURAL RESOURCES
AND ENVIRONMENTAL PROTECTION

G. REYNOLDS WATKINS
CONSULTING ENGINEERS, INC.
Lexington, Bowling Green
& Louisville, Kentucky



LOWER CUMBERLAND RIVER BASIN

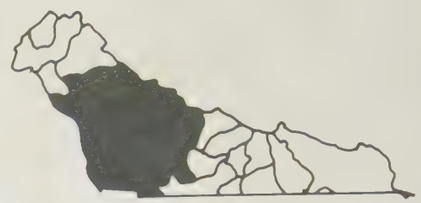


EXHIBIT B-5.1m 5 Thru 10

SEGMENT MAP

LEGEND

DISCHARGERS

- M 00 — MAJOR (OVER 1.0 MGD)
- M 00 — PRINCIPAL (LESS THAN 1.0 MGD)
- (M) MUNICIPAL DISCHARGERS
- (D) DOMESTIC DISCHARGERS
- (I) INDUSTRIAL DISCHARGERS
- SW — SOLID WASTE
- ▲ MINING RELATED

5 4 3 2 1 0 5

GRAPHIC SCALE IN MILES

Base Data: U. S. Geological Survey

KENTUCKY WATER QUALITY MANAGEMENT PLAN

Prepared for Division of Water Quality
KENTUCKY DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION

G. REYNOLDS WATKINS CONSULTING ENGINEERS, INC.
Lexington, Bowling Green & Louisville, Kentucky

Exhibit B-5.3t: Existing Discharge Characteristics (1975)

Code No.	Facility	Location	NPDES Permit No.	Treatment Type	Q7-10 (cfs)	Discharge Characteristics (mg/l)				
						Flow (mgd)	BOD	SS	NH_3	Other
02012	Kentucky State Penitentiary	Lake Barkley 43.7/0.2	KY0026255	Extended Aeration (E.A.)	0	.3300	15	20	2	--
02013	LBL Camping Area	N.A.*[1]	---	Settling Tank w/ Sand Filter (S.T. - S.F.)	Imp.*[2]	.0021	40	100	1	--
02014	Eddy Cr. Marina	Eddy Creek (Barkley) 46.5/5.0/0.2	KY0026432	E.A.	0	.0025	15	20	2	--
02015	H. Shultz Home	N.A.	---	E.A.	Imp.	.0005	15	20	2	--
02016	R. Rice Home	N.A.	---	E.A.	Imp.	.0005	15	20	2	--
02017	Shore Acres	Lake Barkley N.A.	---	E.A.	Imp.	.0005	15	20	2	--
02018	U.S.C.E. Comfort Stations 1 & 2	Eddy Creek 46.5/3.3	KY0026484	S.T. - S.F.	0	.0021	40	100	1	--
02019	Smiths Subdivision	Lake Barkley 43.7/0.4	---	E.A.	Imp.	.0015	15	20	2	--
02020	Dunbar & Sullivan	Lick Creek 42.9/2.5	---	E.A.	0	.0050	15	20	2	--
05021	Tarry-On Camp Resort	Lake Barkley 38.4	---	S.T. - S.F.	Imp.	.0030	40	100	1	--
05022	KOA Camp	Eddy Creek (Barkley) 46.5/9.0/0.6/ 0.2	---	E.A.	0	.0080	15	20	2	--
02024	Heather Hill Campground	Lake Barkley 66.5	KY0022985	E.A.	Imp.	.0060	15	20	2	--
02025	Barkley Inn	Lake Barkley 62.9	---	E.A.	Imp.	.0120	15	20	2	--
02030	Lake View Camp Area	Lake Barkley 58.50	---	E.A.	Imp.	.0090	15	20	2	--
02033	Holiday Hills Camp Area	Eddy Creek 46.5/8.7/0.2	KY0025992	S.T. - S.F.	0	.0021	40	100	1	--
02035	Presbyterian Conference Center	N.A.	---	S.T. - S.F.	Imp.	.0010	40	100	1	--
02036	Kenmarco Inc.	N.A.	---	E.A.	Imp.	.0005	15	20	2	--
02077	Bend of Rivers Development Co.	Lake Barkley 39.1/0.65	KY0024686	E.A.	0	.0250	15	20	2	--
02037	Stubblefield Apts.	Lake Barkley 62.8	---	E.A.	Imp.	.0120	15	20	2	--
02039	Whiting Drive-In	Lake Barkley	---	E.A.	Imp.	.0010	15	20	2	--

*[1]-N.A. - Not Available
*[2]-Imp. refers to the Lake Barkley Impoundments which has a Q7-10 at the Barkley Dam of 5087 cfs.

Exhibit B-5.4t: Waste Load Allocations (1980)

Code No.	Facility	Max. Daily Waste Load lb/day	Proposed Effluent Characteristics/Load Reduction						Priority
			Flow (mgd)	BOD (mg/l)	SS (mg/l)	NH_3 (mg/l)	DO (mg/l)	Other	
02012	Kentucky State Penitentiary	Waste loads are not calculated for this segment since it is Effluent limited.	.030	10/95%	10/96%	1.0/96%	8.0	-	-
02013	LBL Camping Area		.0021	30/85%	30/87%	20/20%	4.0	-	-
02014	Eddy Cr. Marina		.0025	10/95%	10/96%	1.0/96%	8.0	-	-
02015	H. Shultz Home		.0005	30/85%	128/43%	20.0/20%	4.0	-	-
02016	R. Rice Home		.0005	30/85%	30/87%	20.0/20%	4.0	-	-
02017	Shore Acres		.0005	30/85%	30/87%	20.0/20%	4.0	-	-
02018	U.S.C.E. Comfort Stations 1 & 2		.0021	10/95%	11.5/95%	1.0/95%	8.0	-	-
02019	Smith's Subdivision		.0015	30/85%	30/87%	20/20%	4.0	-	-
02020	Dunbar & Sullivan		.0050	10/95%	11.5/95%	1.0/96%	8.0	-	-
02021	Tarry-On Camp Resort		.0030	30/85%	30/87%	20/20%	4.0	-	-
02022	KOA Campground		.0080	10/95%	10/96%	1.0/96%	8.0	-	-
02024	Keather Hill Campground		.0060	10/95%	10/96%	1.0/96%	8.0	-	-
02025	Barkley Inn		.0120	10/95%	10/96%	1.0/96%	8.0	-	-
02030	Lake View Camp Area		.0090	10/95%	10/96%	1.0/96%	8.0	-	-
02033	Holiday Hills Camp Area		.0021	10/95%	11.5/95%	1.0/96%	8.0	-	-
02035	Presbyterian Conference Center		.0010	30/85%	30/87%	20/20%	4.0%	-	-
02036	Kenmarco Inc.		.0005	30/85%	30/87%	20/20%	4.0%	-	-
02077	Bend of Rivers Development Co.		.0250	10/95%	10/96%	1.0/96%	8.0	-	-
02037	Stubblefield Apts.		.0120	10/95%	10/96%	1.0/96%	8.0	-	-
02039	Whiting Drive-In		.0010	30/85%	30/87%	20/20%	4.0	-	-

SEGMENT #6 ANALYSIS

Classification: Water Quality Limited

Priority: 333.45

Location

As shown in B-5.1m, Segment Basin #6 is located in Lyon County. Although the segment contains only 8 square miles, it includes Kuttawa (pop. 453) and Eddyville (pop. 1,981). The segment is also adjacent to the resort area of Lake Barkley.

Basic Planning Data

Segment #6 is projected to add 97 persons, and 47 housing units, between 1970 and 1995 (see Exh. B-6.1t). Over 460 new jobs are projected for the segment between 1975 and 1995. Population density is expected to increase from 44 persons per square mile in 1970 to 56 persons per square mile in 1995. For the same time period, urban-related land use (to accommodate rural non-farm growth) is projected to increase by 0.02 square miles.

Exh. B-6.1t: Segment #6 Basic Planning Data*[1]

	1970	1975	1980	1995
Population Total	352	363	378	449
..Rural	352	363	378	449
..Farm	82	83	87	104
..Non-Farm	270	279	291	345
..Urban	0	0	0	0
Population Density ..Persons/sq.mi.	44.00	45.38	47.25	56.12
Housing Units	104	114	128	151
..Rural	104	114	128	151
..Urban	0	0	0	0
Non-Ag. Employment	-	864	1,049	1,359
..Manufacturing	-	228	315	442
..Non-Manufacturing	-	636	734	911
Land Use Total (sq.mi.)	8.00	8.00	8.00	8.00
..Rural	7.92	7.92	7.92	7.90
..Agriculture	7.92	7.92	7.92	7.90
..Silviculture	.00	.00	.00	.00
..Mining	.00	.00	.00	.00
..Construction	-	-	-	-
..Urban-Related	.08	.08	.08	.10

*[1]-for additional information on basic planning data, see Appendix "A".

Segment Hydrology

Segment 6, as shown in Exhibit B-5.1m, is drained by Hammond Creek, the main stem, and Knob Creek, a tributary west of Hammond Creek. Q7-10 low-flow for Hammond and Knob Creeks is equal to zero (0) cfs. Both creeks received backwater from Lake Barkley to elevation 360 ft. Under the low-flow condition used in the model, the lower part of Hammond Creek would essentially become a nonflowing stagnant pool.

Water Quality Data

Although no monitoring stations exist in segment 6, two stations do exist just outside the area on Crab Creek northwest of Eddyville and on Lick Creek east of Eddyville. The water quality for these stations should be similar to that found in Hammond Creek.

The station on Crab Creek shows that the area has a hardness around 200 mg/1. The pH around 8 indicates the water is slightly alkaline, and the water has a high chlorides content.

The Lick Creek station indicates a neutral pH condition with low dissolved solids content and a low chlorides content.

From the above data, a median water quality for segment 6 can be assumed. This would show a neutral to slightly alkaline water condition due to water hardness caused by limestone solution. Total dissolved solids should not exceed 200 mg/1 with a chlorides content range 6-14 mg/1.

Computer water quality modeling for existing conditions in Hammond Creek show the existing dissolved oxygen levels at Q7-10 low-flow to be below the stream standard of 5 mg/1 and shows toxic NH_3 concentration levels greater than the 4 mg/1 considered as toxic which results in this segment being water quality limited.

Point Source Discharges

Two point source discharges as shown in Exhibit B-6.2t contribute to the waste load of this water quality limited segment.

Eddyville STP discharges 200,000 gpd average daily flow from a trickling filter plant with 75,000 gpd capacity to Hammond Creek near KY 93. A new plant is presently being built to replace this facility and should be in operation in late autumn 1975.

Benberry's Motel discharges a maximum 2100 gpd from a settling tank and sand filter to an unnamed tributary of Knob Creek.

Non-Point Sources

A potential non-point source of pollution in this segment is the gravel pit area near Vista Park in old Kuttawa. The threat of siltation from this area is remote. Scattered houses throughout the area use septic fields for waste disposal. Concentrations are low and danger of ground water contamination is thus minimized. Some non-point pollution is derived from agricultural land in this segment. During heavy rainfall, silt, fertilizer, pesticides, and animal wastes are washed into the streams from farming areas. Agricultural pollution, however, is not considered significant in this segment.

Waste Load Allocations and Priority

To meet the D.O. and NH_3 criteria proposed for 1980 and 1995, the Eddyville plant will need to upgrade its facility to achieve T4B treatment, 95% reduction of the influent waste load. Considering the proposed treatment and the estimated flow for 1980, the Eddyville plant will discharge 35.7 lbs BOD/day if the necessary changes are made. Benberry's Motel will be required to meet the same treatment standards with a waste load allocaion of 0.35 lbs BOD/day as shown in Exhibit B-6.3t.

Exhibit B-6.2t: Existing Discharge Characteristics (1975)

Code No.	Facility	Location	NPDES Permit No.	Treatment Type	Q7-10 (cfs)	Discharge Characteristics (mg/l) Flow (mgd)	BOD	SS	NH_3	Other
02040	Eddyville STP	U.T. - Hammond Cr.- 42.0/1.0/ 2.8/0.3	---	Trickling Filter	0	.2059	141	48	25	--
02034	Benberry's Motel	U.T. - Knob Cr. 42.0/1.0/1.6/0.5	---	Settling Tank w/ Sand Filter	0	.0021	40	100	1	--

Exhibit B-6.3t: Waste Load Allocations (1980)

Code No.	Facility	Max. Daily Waste Load lb/day	Proposed Effluent Characteristics/Load Reduction Flow (mgd)	BOD (mg/l)	SS (mg/l)	NH_3 (mg/l)	DO (mg/l)	Other	Priority
02040	Eddyville STP	35.69	.2137	10/95%	10/96%	1.0/95%	8.0	-	565.2
02034	Benberry's Motel	0.35	.0021	10/95%	10/96%	1.0/95%	8.0	-	-

The segment priority calculations are based on the existing discharge characteristics and the proposed treatment levels. For segment 6, the priority is 333.45, a medium level statewide ranking due to the high level of treatment required at Eddyville.

Municipal Needs

To meet the 1980/1995 goals as shown by the computer water quality model, the Eddyville plant will need to upgrade to treatment T4B exhibiting 10 mg/l BOD_5, 10 mg/l SS, and 1 mg/l NH_3 in the effluent. Other dischargers in the segment should discharge into Eddyville plant if feasible and thus eliminate localized stream pollution and the need for advanced treatment for small flows. The needs as shown in Exhibit B-6.4t to accomplish these goals, include plant expansion to include capacity for 5600 people plus industrial development.

Exhibit B-6.4t: Municipal Needs

Code Number	Facility	1980/1995 Treatment Needs	Costs Millions	Compliance Goals
02040	EDDYVILLE STP	T4B/T4B		7/1/77
		P	.286	
	Priority 565.2	C	.847	
		I	.691	
		I/I	.073	

A new plant is presently under construction which will include two aerated lagoons, secondary clarification, and chlorination. New plant capacity will be 750,000 gpd and should be sufficient to handle the Eddyville area needs for the next twenty years. Projected completion dates are in late autumn 1975.

To achieve the treatment level proposed for 1980, the new plant will have to meet levels of BOD_5 = 10 mg/l, SS = 10 mg/l and NH_3 = 1 mg/l. The less expensive alternative to this level of treatment would be to pump the secondary plant effluent to a discharge point in the main stem of Lake Barkley where the dilution factor and dissolved oxygen content are high. The cost of adding a pump station capable of handling .75 MGD and a 10 inch force main (10,500 ft.) to Lake Barkley would be $286,293.

To correct existing infiltration-inflow problems in Eddyville will take $73,000. Collector needs projected for 1980 were 38,500 feet at a cost of $847,000. Estimated interceptor needs for 1995 were 21,120 feet at a projected cost of $690,624.

Alternative Water Quality Management Plans

One alternative to pumping was considered for the Eddyville plant. By installing mixed media filtration in the new plant, the effluent standards for T4B can be met. This 750,000 gpd filter system would cost approximately $408,750 in 1975.

It is anticipated that the Eddyville system and the very near Kuttawa system will plan to serve the needs of the smaller dischargers in this area with the completion of the 201 Facilities Plans.

Presently, no nutrient control is required for the Lake Barkley impoundment. Water quality data in both the upper Cumberland River and the lower Cumberland River indicate the level of phosphorous in Lake Barkley is due to background levels and not to any specific discharges. These levels in the LCRB range from .01 mg/l in Lake Barkley Canal to 0.87 mg/l in the Little River near Cadiz. Average monitored levels in the basin are about 0.23 mg/l with average levels measured in Lake Barkley at about .05 mg/l. According to a recent memo from Region IV EPA, phosphorous levels in excess of 0.025 mg/l could cause eutrophication. Before phosphorous removal from sewage effluent is recommended, a thorough study of background phosphorous level in streams feeding the

impoundments should be made. Indications in the lower and upper Cumberland River Basins indicate high phosphorous background levels and lower average phosphorous levels in the impoundment. No significant indication of eutrophication is apparant in Lake Barkley to our knowledge.

Small discharges into streams with Q7-10 flow equal to zero should be considered for only secondary effluent requirements since they are insignificant in size and the T4B treatment levels would be a harsh demand on the small discharge owners.

SEGMENT #7 ANALYSIS

Classification: Water Quality Limited

Priority: 242.64

Location

As shown in Exhibit B-5.1m, Segment Basin #7 is located in Lyon County. The basin countains only 6 square miles of surface area which includes a portion of the city of Kuttawa (pop. 453). The segment is adjacent to Lake Barkley.

Basic Planning Data

Segment #7 is projected to add 64 persons, and 31 housing units, between 1970 and 1995. No new employment opportunities are projected within the segment basin. Population density is expected to increase from 39 persons per square mile in 1970 to 50 persons per square mile in 1995. Urban-related land use is projected to increase by 0.01 square mile.

Exh. B-7.1t: Segment #7 Basic Planning Data*[1]

	1970	1975	1980	1995
Population Total	235	242	252	299
..Rural	235	242	252	299
..Farm	54	56	58	69
..Non-Farm	181	186	194	230
..Urban	0	0	0	0
Population Density ..Persons/sq.mi.	39.20	40.00	42.00	50.00
Housing Units	70	76	85	101
..Rural	70	76	85	101
..Urban	0	0	0	0
Non-Ag. Employment	-	-	-	-
..Manufacturing	-	-	-	-
..Non-Manufacturing	-	-	--	-
Land Use Total (sq.mi.)	6.00	6.00	6.00	6.00
..Rural	5.95	5.95	5.95	5.94
..Agriculture	5.95	5.95	5.95	5.94
..Silviculture	.00	.00	.00	.00
..Mining	.00	.00	.00	.00
..Construction	-	-	-	-
..Urban-Related	.05	.05	.05	.06

*[1]-for additional information on basic planning data, see Appendix "A".

Segment Hydrology

Segment 7 includes Poplar Creek and its unnamed tributaries as shown by Exhibit B-5.1m. Poplar Creek has a Q7-10 low-flow equal to zero and accepts the waste from Kuttawa STP. At normal pool elevation, Lake Barkley backs into the Poplar Creek embayment at mean sea level elevation of 360 feet. At high water, the lake rises to 375 feet elevation above mean sea level and extends into the valleys where minor upstream tributaries feed the creek.

Water Quality Data

Water quality in segment 7 as shown on the 1980 computer model run implies that a dissolved oxygen deficit occurs in Poplar Creek when the zero flow Q7-10 condition exists. For this reason, the segment was classified Water Quality Limited. No monitoring stations are located in segment 7 and the only point which collects water quality data is the Kuttawa Sewage Treatment Plant located on an unnamed tributary of Poplar Creek. This is a public recreation area and should be monitored in accordance with that standard.

Point Source Discharges

As shown in Exhibit B-7.2t, there are four point source dischargers in segment 7. A brief description of each follows:

Kuttawa Sewage Treatment Plant, the largest of the discharges has a capacity of 350,000 gpd and treats approximately 47,000 gpd of sewage as estimated for population served and discharges the effluent to an unnamed tributary of Poplar Creek only 0.6 miles from the creek. Estimated values shown in Exhibit B-7.2t indicate the activated sludge plant is already meeting better than secondary treatment requirements.

The Ashland Oil Company discharges 500 gpd sanitary sewage from a settling tank and sand filter. This discharge flows into Poplar Creek near the mouth at Lake Barkley.

Bar-X Mobile Home Park has a discharge capacity of 4,500 gpd from a settling tank and sand filter operation near Suwanee on US 62. The discharge flows to an unnamed tributary of Poplar Creek.

D & D Standard Oil has a capacity of 4,500 gpd from a settling tank and sand filter facility on Poplar Creek near KY 295. Each of these point sources will require upgrading to meet the 1977 standards calling for best practical treatment and secondary treatment.

Non-Point Source Discharges

Scattered septic tanks and drain fields and agricultural operations contribute what little non-point pollution there is in this segment. The septic fields pose no major health hazard for Kuttawa since its drinking water is obtained from the Lyon County Water District. The agricultural operations contribute silt, fertilizers, pesticides, and animal waste primarily to surface waters during rainfall intensities.

Wasteload Allocations and Priority

The water quality model for 1975 predicted a D.O. deficit in Poplar Creek due to effluent from Kuttawa

STP and three other minor discharges. The 1980 model which assumed secondary treatment also showed a D.O deficit. This is primarily because of the low-flow condition for Q7-10 used in the model. The proposed effluent characteristics for these dischargers to meet stream standards are listed in Exhibit B-7.3t. Poplar Creek in the main stem will always contain backwater from Lake Barkley. This water, however, will probably have very little velocity at the low-flow condition creating the equivalent of a stagnant pond. For this reason, segment 7 is not expected to meet water quality standards even after application of secondary treatment and is thus classified as Water Quality Limited. The segment priority was calculated to be 242.64 ranking in the medium state-wide range.

Exhibit B-7.4t: Municipal Needs

Code Number	Facility	1980/1995 Treatment Needs	Costs Million	Compliance Goals
02011	KUTTAWA STP Priority 485.3	T1A/T1A P	0.114	6/30/77

P - Pumping

Needs for this operation would include a pump station and 5000 feet of 6 inch force main at a total 1975 estimated cost of $114,000 including operation and maintenance for twenty years.

Exhibit B-7.2t: Existing Discharge Characteristics (1975)

Code No.	Facility	Location	NPDES Permit No.	Treatment Type	Q7-10 (cfs)	Discharge Characteristics (mg/l) Flow (mgd)	BOD	SS	NH_3	Other
02082	Ashland Oil	Poplar Cr.-Lake Barkley - 39.7/ 0.6	KY0022071	Settling Tank w/ Sand Filter (S.T. and S.F.)	0	.0005	40	100	1	--
02041	Bar-X Mobile Home Park	U.T. - Poplar Cr. 39.7/2.2/0.80	KY0025267	S.T. and S.F.	0	.0045	40	100	1	--
02042	D & D Standard Oil	U.T. - Poplar Cr. - 39.7/ 3.5/0.45	---	S.T. and S.F.	0	.0045	40	100	1	--
02011	Kuttawa STP	U.T. - Poplar Cr. - 39.7/ 1.8/0.60	KY0020419	Activated Sludge	0	.8350	15	20	20	--

Exhibit B-7.3t: Waste Load Allocations (1980)

Code No.	Facility	Max. Daily Waste Load lb/day	Proposed Effluent Characteristics/Load Reduction Flow (mgd)	BOD (mg/l)	SS (mg/l)	NH_3 (mg/l)	DO (mg/l)	Other	Priority
02082	Ashland Oil	0.58	.0005	10/95%	10.0/96%	1.0/96%	8.0	-	-
02041	Bar-X Mobile Home Park	0.67	.0045	10/95%	10.0/96%	1.0/96%	8.0	-	-
02042	D & D Standard Oil	0.67	.0045	10/95%	10.0/96%	1.0/96%	8.0	-	-
02011	Kuttawa STP	3.67	.0489	3/98%	3.0/99%	1.0/96%	8.0	-	485.3

The facility priority for Kuttawa is 485.3 as calculated using the treatment needs costs and the KDNREP facilities cost factors. Based on the predicted flow rate and the recommended treatment level T5B (3 mg/l BOD_5, 3 mg/l SS, and 1 mg/l NH_3), the Kuttawa plant will produce 3.67 lbs. BOD/day as shown in Exhibit B-7.3t.

Municipal Needs

The Kuttawa activated sludge operation will need to be upgraded to meet the stricter levels of compliance recommended in view of the critical D.O. condition at low-flow in Poplar Creek. The most cost effective solution, rather than meet T5B requirements, is pumping the treated effluent (T1A) to Lake Barkley as shown in Exhibit B-7.4t.

Alternative Water Quality Management Plans

The cost of meeting treatment needs for Poplar Creek would include the addition of mixed media filtration for BOD_5 and SS removal. These additions could be made for a 100,000 gpd operation at a total cost including operation and maintenance for twenty years of $130,000. This alternative is very close in cost to the first alternate. The first, however, is probably more feasible since the force main required would be less than 5000 feet if pumping was only to the edge of Lake Barkley instead of the central portion of the lake. These two solutions should be compared in much greater detail in the future 201 Facilities Plan for Kuttawa.

Recommendations for Revising Water Quality Standards

The case of Kuttawa STP is one of several in

which the actual discharge flows into a portion of a stream very near to a lake, but with a Q7-10 equal to zero. Kuttawa STP lies only 2.4 miles from the mouth at Poplar Creek and the lower portion of the creek is actually part of the lake. It would be more feasible to change the water quality standards to make secondary treatment requirements sufficient for discharges on streams flowing into large bodies of water which are actually a part of that body.

It would also seem most beneficial to require the small dischargers on zero Q7-10 flow streams to install only secondary levels of treatment rather than the stringent and costly methods recommended by this computer modeling. A flow under which dischargers would be classed as small or nonsignificant might best be 50,000 gpd.

SEGMENT #8 ANALYSIS

Classification: Water Quality Limited

Priority: 292.77

Location

As shown in Exhibit B-5.1m, Segment Basin #8 is located in Lyon, Caldwell, and Trigg Counties. The basin contains 78.75 square miles, with 64 percent of the surface area located in Caldwell County. Princeton, the second largest city in the Lower Cumberland River Basin, is located in the northeast corner of the segment.

Basic Planning Data

Segment #8 is an area that will be experiencing a rapid rate of growth (see Exh. B-8.1t). Between 1970 and 1995, it is projected that Segment #8 will acquire 4,189 persons and 1,499 new housing units. Over 3,000 new job opportunities are projected for the area. It is projected that 1.15 square miles of new urban-related land use will be added to accommodate the population growth.

Exh. B-8.1t: Segment #8 Basic Planning Data*[1]

	1970	1975	1980	1995
Population Total	7,585	8,192	8,844	11,774
..Rural	1,922	1,972	2,024	2,307
..Farm	575	588	604	685
..Non-Farm	1,347	1,384	1,420	1,622
..Urban	5,663	6,220	6,820	9,467
Population Density ..Persons/sq.mi.	96.32	104.02	112.30	150.00
Housing Units	2,587	2,898	3,265	4,086
..Rural	631	674	728	882
..Urban	1,956	2,224	2,537	3,194
Non-Ag. Employment	-	5,119	6,420	8,190
..Manufacturing	-	2,445	3,313	4,332
..Non-Manufacturing	-	2,674	3,107	3,858
Land Use Total (sq.mi.)	78.75	78.75	78.75	78.75
..Rural	76.74	76.57	76.39	75.59
..Agriculture	75.31	75.14	74.96	74.16
..Silviculture	1.53	1.35	1.35	1.35
..Mining	.08	.08	.08	.08
..Construction	-	-	-	-
..Urban-Related	1.97	2.14	2.32	3.12

*[1]-for additional information on basic planning data, see Appendix "A".

Segment Hydrology

As shown by Exhibit B-5.1m, Eddy Creek and its main tributary, Dry Creek, drain 78 square miles forming segment 8 in Caldwell and Lyon Counties 0.7 cft. Q7-10 for Dry Creek is zero. The smaller tributaries to Eddy Creek are all zero Q7-10 flow condition streams. This area has a Karst topography and many small springs and sinkholes are prevalent in this area.

Water Quality Data

Only one monitor site with data was found in the STORET System. At Eddy Creek near Lamasco, the average flow was 18 cfs with 255 mg/l dissolved solids, pH equal to 7.9, phosphorous .27 mg/l, and an average concentration of sulfates and chlorides. The 1975 and 1980 computer models for Eddy and Dry Creeks indicate a D.O. deficit due to the sewage loads from Princeton STP discharging into the headwaters of Eddy Creek and the ITT Grinnell Corporation discharging into Wede Branch.

Point Source Discharges

Three point source discharges of record as shown in Exhibit B-8.2t contribute to the waste load in the segment.

Princeton STP discharging at M.P. 21.6, Eddy Creek has a trickling filter capable of handling 0.9 MGD. Average flow in the plant is 600,000 gpd with heavy infiltration during storm periods. The plant presently removing 80% BOD and SS will need to increase treatment for 95% removal to meet the 1980 proposed waste load allocations shown by Exhibit B-8.4t.

The ITT Grinnell Corporation, Welding Division, discharges into an open drainage ditch which runs into a cave. The extended aeration plant has a capacity of 7500 gpd. To meet the 1980 waste load allocation proposed, the plant will need to be upgraded to a 95% removal efficiency.

The Cedar Bluff Stone Company has a permit to discharge storm water to Goose Creek with a maximum SS concentration of 55 mg/l.

Non-Point Source Discharges

Although Princeton has a municipal sewage treatment system, many of the residents have elected not to connect to city sewers. As a result, septic tank problems still exist within the city. The quickly growing areas around Princeton are largely being built without sewers and are left dependent on septic fields in a soil not suitable for such use.

The Cedar Bluff area east of Princeton is dependent on contaminated water supplies due to ground water conditions created by septic fields. This rural area serves around 5000 people with water that is contaminated 65% of the time.*[2] Several mines and a quarry exist near Cedar Bluff although the area does not record any abnormal pH values or high SS concentrations from the sources.

Some agricultural and silvicultural (forestry) operation contribute to non-point pollution in this

*2 Comprehensive Sewer and Water Plan, Pennyrile Area Development District, 1973.

segment but it is not known to be significant. Silt, fertilizer, pesticides and animal wastes are washed from these areas of operation during times of heavy rainfall.

Waste Load Allocation and Priority

The 1975 and 1980 computer models show a dissolved oxygen deficit in Eddy Creek downstream from Princeton and in Dry Creek downstream from the Grinnell Corporation. If the Princeton and Grinnell plants both are upgraded to meet the effluent limitations recommended above, they could discharge a total 127.59 lbs. BOD/day at the estimated 1980 flows and still meet the minimum standards shown in Exhibit B-8.3t.

Exhibit 8.4t: Municipal Needs

Code Number	Facility	1980/1995 Treatment Needs	Cost Million	Compliance Goals
02043	Princeton STP	T4B/T4B		1977
		T	0.823	
		I	0.863	
		C	0.647	
		I/I	0.621	

T - Treatment Needs
I - Interceptor Needs
C - Collector Needs
I/I-Infiltration/Inflow Needs

Exhibit B-8.2t: Existing Discharge Characteristics (1975)

Code No.	Facility	Location	NPDES Permit No.	Treatment Type	Q7-10 (cfs)	Discharge Characteristics (mg/l) Flow (mgd)	BOD	SS	NH_3	Other
02043	Princeton STP	Eddy Creek 46.5/21.6	N/A*[1]	Trickling Filter	0.70	.6911	20	63	25	--
02044	ITT Grinnell Corporation	Wede Branch 46.5/14.0/5.8/1.0/1.2	App.# KY0022225	Extended Aeration	0	.0075	N/A	N/A	N/A	--
02038	Cedar Bluff Stone Company	Goose Creek 46.5/19.7/5.5/0.3	KY0001406	Lagoon	N/A	N/A	N/A	55	N/A	--

Exhibit B-8.3t: Waste Load Allocations (1980)

Code No.	Facility	Max. Daily Waste Load lb/day	Proposed Effluent Characteristics/Load Reduction Flow (mgd)	BOD (mg/l)	SS (mg/l)	NH_3 (mg/l)	DO (mg/l)	Other	Priority
02043	Princeton STP	126.43	.7578	10/95%	10.0/96%	1.0/96%	8.0	-	695.3
02044	ITT Grinnell Corporation	1.16	.0075	10/95%	10/96%	1.0/96%	8.0	-	-
02038	Cedar Bluff Stone Co.	N/A*	N/A*	N/A*	55	N/A*	N/A*	-	-

*N/A refers to information not available or nonexistent at this time.

Segment priority was calculated as 292.77, a medium statewide ranking. The discharge priority for Princeton, 695.33, is based on the municipal needs estimates below.

Municipal Needs

The Princeton STP, presently discharging 600,000 gpd based on population, suffers from infiltration-inflow problems. The 1980 needs costs include estimates for correction of this situation. Projected flow for 1995 is 1.05 MGD, 150,000 gpd greater than present plant capacity. To effectively treat this flow, the plant will need to expand by 1995. The present operation is a high rate trickling filter with primary and secondary clarifiers, anaerobic digestion of sludge, followed by sludge drying beds with farm spreading of dried sludge.

The changes needed to meet T4B treatment which is adequate for 1980 and 1995 will include the addition of biological-nitrification and mixed media filtration. These additions based on the present capacity of .9 MGD would have a 1975 estimated cost of $495,400.

Estimated plant expansion for 1995 to 1.05 MGD plus the added filtration and nitrification capacity would have a 1975 cost of $823,222.

To fully service the Princeton peripheral area, 26,400 feet of interceptors need to be added by 1995 at a 1975 cost of $863,280. Collector sewers estimated for 1980 needs would take 27,000 feet at a 1975 cost of $647,250.

Presently, the infiltration-inflow rate is high in the sewer system. To analyze and correct this problem would require an estimated cost of $621,000 in 1975. The total extimated needs for Princeton, including infiltration corrections, plant expansion and upgrading, collector needs, and interceptor needs would have a 1975 cost of $1.444 million.

Alternative Water Quality Management Plans

The Princeton area has been designated a 201 Planning Area by the Kentucky Department for Natural Resources and Environmental Protection. When the Facilities Plan has been completed, a more detailed analysis and cost estimate will be available.

Presently, the city has not required all residents to connect to the sewer system. As a result, septic problems are serious in some areas. These areas should be analyzed and, if feasible, sewered in the future to combat potential health problems.

Alternatives to tertiary treatment for Princeton were investigated. It was found infeasible to use land spreading of the existing secondary effluent due to poor soil assimilation of sewage wastes in this segment. Land application of wastes in this segment is also seriously limited by the Karst topography pockmarked with sinkholes which give ready access of waste to the groundwater.

Pumping or gravity flow of secondary wastes to another major treatment facility or to a stream with high enough Q7-10 low-flows for proper dilution and assimilation of secondary waste flow of this magnitude is not feasible due to the long transmission distances and related costs.

SEGMENT #9 ANALYSIS

Classification: Effluent Limited Priority: 6.20

Location

As shown in Exhibit B-5.1m, Segment Basin #9 is located in Caldwell, Trigg and Christian Counties. The total surface area of segment #9 is 144.2 square miles, with 44 percent of this total in Trigg County, 34 percent in Caldwell, and 22 percent in Christian County. The largest populated place in segment #9 is Cerulean (pop. 253) located in Trigg County. A portion of the Pennyrile Forest State Park is located within segment #9.

Basic Planning Data

Segment #9 is projected to add 688 persons, and 334 housing units, between 1970 and 1995. No new employment opportunities are projected within the segment basin. Population density is expected to increase from 24 persons per square mile in 1970 to 30 persons per square mile in 1995. For the same time period, urban-related land use is projected to increase by 0.14 square miles.

Exh. B-9.1t: Segment #9 Basic Planning Data*[1]

	1970	1975	1980	1995
Population Total	3,566	3,585	3,670	4,254
..Rural	3,566	3,585	3,670	4,254
..Farm	1,131	1,137	1,163	1,338
..Non-Farm	2,435	2,175	2,507	2,916
..Urban	0	0	0	0
Population Density ..Persons/sq.mi.	24.73	24.86	25.45	30.00
Housing Units	1,104	1,143	1,207	1,438
..Rural	1,104	1,143	1,207	1,438
..Urban	0	0	0	0
Non-Ag. Employment	-	-	-	-
..Manufacturing	-	-	-	-
..Non-Manufacturing	-	-	-	-
Land Use Total (sq.mi.)	144.20	144.20	144.20	144.20
..Rural	143.52	143.51	143.50	143.19
..Agriculture	143.52	143.51	143.50	143.19
..Silviculture	.00	.00	.00	.00
..Mining	.00	.00	.00	.00
..Construction	-	-	-	-
..Urban-Related	.68	.69	.70	.82

*[1]-for additional information on basic planning data, see Appendix "A".

Segment Hydrology

As shown by Exhibit B-5.1m, Segment #9 drains approximately 144 square miles of topography varying from rolling and flat to hilly and mountainous. The area making up this segment is typical of karst topography with sinkholes and springs abounding throughout. The segment main stem, Muddy Fork Little River, runs southwest through Trigg and Christian Counties and touches Caldwell County. Tributaries include Millwood Creek, Wallace Fork, Kenady Creek, Brushy Grove Creek, Horse Creek, and Sugar Creek. Many minor, unnamed tributaries complete the segment drainage. Stream elevations vary from 350 feet at the mouth to 650 feet at the headwaters.

The Q7-10 value for the drainage area at the confluence of Muddy Fork with Little River is 0.6 cfs. Q7-10 is zero on Millwood Creek, Wallace Fork, Sugar Creek, Horse Creek, and the Muddy Fork until it is joined by Kenady Creek.

Water Quality Data

No monitor stations exist in Segment #9, but, from all reasonable estimates, water quality is very good. The 1975 and 1980 computer models predicted no D.O. deficit in this segment. This is due primarily to the scarcity of point source dischargers in the segment.

Point Source Discharges

Only one point source discharge on record with the state exists in this segment. The William Turner Hog Parlor (hog feed lot) discharges 2,200 gpd into a lagoon which exfiltrates to groundwater entering Muddy Fork. This discharge, near Cerrulean Springs, could easily be called a non-point source, but does not significantly affect the water quality of Muddy Fork.

Non-Point Source Discharges

Two small communities in Segment #9 are minor non-point sources of groundwater pollution and are potential future point source dischargers. Wallonia, in Trigg County, located on KY 128, 2 miles south of the Caldwell County line disposes of their domestic waste with septic tanks, cesspools, and pit-toilets. Cerrulean Springs on KY 124, one mile south of the Christian County line in Trigg County, has a population of approximately 300 using primarily septic tank and similar means of sewage disposal. The rural population throughout the segment mainly use pit-type latrine installations, septic tanks with leaching fields or cesspools, for disposing of domestic sewage. These non-point sources are not significant to the overall stream water quality, but do in some cases affect local groundwater quality.

Other minor non-point sources of pollution in this segment are generated by agricultural soil erosion, fertilizer, pesticide, and animal waste runoff.

Priority

The segment 9 priority is only 6.20 due to the absence of significant point and non-point discharges in this area.

Existing Discharge Characteristics (1975)

The Wm. Turner Hog Parlor, as described in Exhibit 9.2t, discharging 2,200 gpd maximum from a feed lot operation, uses a "non-discharging" lagoon to treat the effluent. Effluent characteristics have been estimated as follows: BOD - 40 mg/1, SS - 100 mg/1, NH_3 - 1 mg/1. These values are estimates only based on available information concerning lagoon treatment efficiencies.

Waste Load Allocations (1980)

The Wm. Turner Hog Parlor, code number 02047, will need to meet T4B treatment in 1980 to compliment the stream standards on this zero low flow portion of Muddy Fork. This treatment is estimated to produce 10 mg/1 BOD, 10 mg/1 SS, and 1 mg/1 NH_3.

Municipal Needs

No municipalities have point discharges in this segment.

Alternative Water Quality Management Plans

The only water quality management planning performed for this segment has been the computer stream modeling. As mentioned under waste load allocations, this model shows the treatment level required for water quality to be met in the receiving stream for the Wm. Turner Hog Parlor. No alternative planning has been investigated since this point source is not significant.

Exhibit B-9.2t: Existing Discharge Characteristics (1975)

Code No.	Facility	Location	NPDES Permit No.	Treatment Type	Q7-10 (cfs)	Discharge Characteristics (mg/1)				
						Flow (mgd)	BOD	SS	NH_3	Other
02047	Wm. Turner Hog Parlor	Muddy Fk. Little River	N/A	Lagoon	0	.0022	40	100	1	--

Exhibit B-9-3t: Waste Load Allocations (1980)

Code No.	Facility	Max. Daily Waste Load lb/day	Proposed Effluent Characteristics/Load Reduction						Priority
			Flow (mgd)	BOD (mg/1)	SS (mg/1)	NH_3 (mg/1)	DO (mg/1)	Other	
02047	Wm. Turner Hog Parlor	0.37	.0022	10/95%	10/96%	1.0/95%	8.0		

SEGMENT #10 ANALYSIS

Classification: Effluent Limited Priority: 169.50

Location

As shown in Exhibit B-5.1m, Segment Basin #10 is located in Trigg and Christian Counties, and is the third largest segment in the Lower Cumberland River Basin. The segment contains 283.25 square miles of surface area, with 59 percent of the segment land situated in Trigg County and 41 percent in Christian County. Cadiz (pop. 1,987) is the largest populated place in segment #10. A close neighbor of Cadiz is the new Lake Barkley Resort State Park, seven miles to the west. A portion of Ft. Campbell Military Reservation also shares part of the segment, eleven miles south of Cadiz.

Basic Planning Data

Segment #10 has a projected increase of 1,790 persons and 646 housing units, between 1970 and 1995 (see Exh. B-10.1t). Over 1,000 new employment opportunities are projected for the area, and population density is expected to increase from 28 persons per square miles in 1970 to 33 persons per square miles in 1995. Urban-related land use is projected to increase by 0.35 square miles to accommodate rural non-farm population growth.

Exh. B-10.1t: Segment #10 Basic Planning Data*[1]

	1970	1975	1980	1995
Population Total	7,790	7,764	8,005	9,580
..Rural	7,790	7,764	8,005	9,580
..Farm	2,425	2,417	2,490	2,947
..Non-Farm	5,365	5,347	5,515	6,633
..Urban	0	0	0	0
Population Density				
..Persons/sq.mi.	28.00	27.41	28.26	33.82
Housing Units	2,279	2,331	2,465	2,925
..Rural	2,279	2,331	2,465	2,925
..Urban	0	0	0	0
Non-Ag. Employment	-	1,970	2,409	3,046
..Manufacturing	-	625	832	1,066
..Non-Manufacturing	-	1,345	1,577	1,980
Land Use Total (sq.mi.)	283.25	283.25	283.25	283.25
..Rural	281.74	281.74	281.70	281.39
..Agriculture	277.54	277.54	277.50	277.19
..Silviculture	4.20	4.20	4.20	4.20
..Mining	.00	.00	.00	.00
..Construction	-	-	-	-
..Urban-Related	1.51	1.51	1.55	1.86

*[1]-for additional information on basic planning data, see Appendix "A".

Segment Hydrology

Segment #10 as shown by Exhibit B-5.1m drains 283 square miles on Trigg and Christian Counties through a vast network of streams tributary to the Little River. This segment begins at milepoint 59.0 on the Cumberland River, (Lake Barkley) and forming solution cavities and sinkholes, ends at M.P. 49.75 on the Little River near Herndon, Kentucky, and includes all the tributaries serving this reach. This area is a rolling and often karst topography due to the underlying limestone Q7-10 low flows on the Little River ranges from 8 cfs at the upstream end of the segment to 25 cfs at the mouth of the Little River at Lake Barkley. Tributaries include Blue Spring Creek, Carrey Creek, Burge Creek, Sinking Fork, Potts Creek, and Casey Creek. Q7-10 values on these tributaries range from 0 to 1 cfs except for Sinking Fork, where values range from 0 to 3.85 cfs. Groundwater is adequate for domestic use. Natural ponds, sinkholes, caves, and springs are prevalent throughout the segment.

Water Quality Data

Two water quality stations exist in the segment, one above Cadiz and one on the Little River. These stations indicate a dissolved solids content less than 250 mg/l, hardness less than a 200 mg/l, a slightly alkaline water condition, and flows ranging from 52 cfs to 2900 cfs between October 1960 and June 1961. Mean flow value for this period was 618 cfs. On the basis of the data found in Appendix A-1, the general water quality of the Little River in this segment seems to be excellent. The data presented are the best available data at the present time.

Point Source Discharges

Eleven point sources are recorded for Segment #10 as listed in Exhibit B-10.2t and shown in Exhibit B-5.1m, the largest being Cadiz STP. These discharges, are located in two major groups, by area.

In the general vicinity of Cadiz, we find the Cadiz STP, Shady Lawn Nursing Home, Trigg County Maintenance Building, Thomas Hog Parlor, and Hoover Manufacturing. The second group, located in the Lake Barkley portion of the Little River, includes the Barkley State Park, Christman Motel, and the Boat Haven.

The Cadiz Treatment plant capacity of 300,000 gpd, receives an average daily flow of 87,000 gpd. This contact stabilization factory built plant was installed in 1964 and, according to the 201 Base Data Report*[2], the plant operates at 95% BOD removal rate.

*[2]-Base Data, Cadiz 201 Facilities Plan, Draft Copy GRW Cons. Engrs., Lexington, Kentucky.

The Hoover Manufacturing Company treats an average 8750 gpd in a 10,000 gpd capacity plant with 92% BOD removal. This extended aeration plant discharges to a lagoon from which the effluent exfiltrates into the soil. For analytical purposes it has been assumed that due to the karst topography in this region, this effluent flows to the Little River.

Shady Lawn Nursing Home, with a 7500 gpd extended aeration plant treats 6000 gpd domestic sewage and discharges to a lagoon. Effluent filters into the soil and through the underground system into Little River.

The Trigg County Maintenance Building discharges 800 gpd through a 1000 gpd extended aeration plant to an unnamed tributary of Caney Creek. Estimated BOD removal is 92%. Caney Creek at this point has a Water Quality Limited subreach if the effluent dissolved oxygen is less than 5 mg/l.

Barkley Lake State Park has two treatment plants. A 40,000 gpd plant on Blue Spring Creek is extended aeration and should operate with 90% BOD and SS removal. An 80,000 gpd plant on the Little River should operate at similar efficiency.

The other smaller discharges in the segment discharge 2000 gpd or less. Christman Motel and Boat Haven both have extended aeration plants and discharge into the Little River. Thomas Hog Parlor and and Rogers Hog Parlor both discharge from lagoons into streams with Q7-10 low flows equal to zero.

Non-Point Source Discharges

Non-point sources of pollution in this segment are shown by Exhibit B-5.1m. Many peripheral suburban areas surrounding Cadiz, as well as rural residents, dispose of wastewater primarily by septic tanks or field drainage systems.

The lots adjoining Lake Barkley (all outside the 201 Area) are under Federal jurisdiction and permits are required for waste disposal systems to prevent contamination of Lake Barkley. Prior to June 21, 1974 there were no septic tank regulations for Trigg County.

The Kentucky Plumbing Code regulations are required of all septic tanks, but no percolation tests or minimum lot sizes are specified.

The County Health Department reports difficulty with many of the septic tanks located in subdivisions near Cadiz. Kings Chapel Estates, Stallions Hillview Subdivision, Woods and Cain Subdivisions, Noel Subdivision, Cunningham Lots, Whitecreast Subdivision, Woodlawn Estates, Allen Subdivision, and Joe Handley

Exhibit B-10.2t: Existing Discharge Characteristics (1975)

Code No.	Facility	Location	NPDES Permit No.	Treatment Type	Q7-10 (cfs)	Discharge Characteristics (mg/1)				
						Flow (mgd)	BOD	SS	NH_3	Other
02048	Cadiz STP	Little River 59.0/17.4	KY0026891	Contact Stabilization	15.67	.0870	12	20	2	--
02049	Thomas Hog Parlor	Lagoon at M.P. 59.0/20.3/4.4/ 1.6	---	Lagoon	0	.0022	40	100	1	--
02050	Rogers Hog Parlor	N/A	---	Lagoon	0	.0022	40	100	1	--
02051	Hoover Manufact. Company	Pond Located at 59.0/23.6/2.1/ 1.1/0.7	---	Extended Aeration (E.A.)	0	.0080	15	20	2	--
02052	Shady Lawn Nursing Home	Lagoon at M.P. 59.0/11.7/11.3 1.6/0.6	---	Lagoon	0	.0060	15	20	2	--
02053	Trigg Co. Maint. Building	Caney Creek 59.0/18.0/3.3/ 0.5	KY002555	E.A.	0	.0010	15	20	2	--
02026	Barkley Lake State Park	Blue Spring Cr. 59.0/2.5/2.2	KY0024473	E.A.	0	.040	15	20	2	--
02076	Barkley Lake State Park	Little River 59.0/4.4	KY0024473	E.A.	22	.080	15	20	2	--
02028	Christman Motel	Blue Spring Cr. 59.0/2.5/2.8	---	E.A.	0	.0021	15	20	2	--
02029	Boat Haven	Little River 59.0/8.9	---	E.A.	18	.0010	15	20	2	--
02148	Cadiz Water Dept.	Little River 59.0/18.3	KY0027570		15	N/A	N/A	30	N/A	--

Lots all utilize septic tanks.

An increasing number of wells in this karst region are reported as contaminated (65% of those tested). Inefficient septic tanks are reported as the primary cause of contamination.

The soils suited for septic tank absorption fields are low to moderate sloped Brandon, Mountview, and Baxter soils. The most severely limited soil is Lax, in the southern 201 Area.

According to the Trigg County Health Department, no records of private septic tank installations are made. An estimate of installations is 1,200 for the county.

The rural areas of segment 10 in Christian County are similar to those in Trigg County and similar disposal methods are used. No significant mining areas exist and mine influence is considered nonexistent.

Agricultural and silvicultural (forestry) operations in this segment are a source of some non-point pollution from siltation, pesticides, fertilizers and animal wastes during periods of heavy rainfall.

Waste Load Allocations and Priority

Waste load allocations for 1980 are listed in Exhibit B-10.3t. These were determined using the stream Q7-10 low flows at the point of discharge and the treatment type needed to meet DO and NH_3 toxicity levels standards for 1980 waste flows. Allocations for plants on streams with a medium or high Q7-10 low flow were set by the computer model to secondary treatment levels. Those on zero low flow streams have tertiary treatment porposed to meet the stream standards.

Municipal Needs

The Cadiz STP is presently discharging effluent which meets the 1977 standards for 30 mg/l BOD and 30 mg/l SS. Little River at this point has sufficient assimilative capacity to handle this secondary effluent for 1960 and 1995 as shown by the computer model. Therefore the Cadiz plant will need no alterations to meet the proposed 1980 standards. The estimated 1995 flow is approximately 370,000 gpd based on population projections given in the Cadiz Base Data for the 201 Facility. Should this population be achieved the present plant will need expanding. This flow projection was based on an average 100 gpd/capita, a value which presently is very high from records for the populous of Cadiz. It is therefore anticipated that the present plant will be adequate until 1995. Interceptor needs to 1995 include 26,000 feet of sewer at a 1975 present worth of $0.85 million. Collector needs to serve the community in 1980 are estimated at 14,000 feet with a 1975 present worth of $0.33 million. Some infiltration-inflow problems are overloading the present plant during storm periods. These problems could be resolved for an estimated 1975 cost of $0.128 million.

Exhibit 10.4t: Municipal Needs

Code Number	Facility	1980/1995 Treatment Needs	Costs Millions	Compliance Goals
02048	Cadiz STP	T1B/T1B		7/1/77
		C	0.335	
		I	0.850	
		I/I	0.128	

Exhibit B-10.3t: Waste Load Allocations (1980)

Code No.	Facility	Max. Daily Waste Load lb/day	Proposed Effluent Characteristics/Load Reduction						Priority
			Flow (mgd)	BOD (mg/l)	SS (mg/l)	NH_3 (mg/l)	DO (mg/l)	Other	
02048	Cadiz STP	337.8	.3000	30/87%	30/87%	20/20%	4.0	-	287.3
02049	Thomas Hog Parlor	.37	.0022	10/95%	10/96%	1/96%	8.0	-	-
02050	Rogers Hog Parlor	.37	.0022	10/95%	10/96%	1/96%	8.0	-	-
02051	Hoover Man. Company	1.67	.0100	10/95%	10/96%	1/96%	8.0	-	-
02052	Shady Lawn Nursing Home	1.00	.0060	10/95%	10/96%	1.0/96%	8.0	-	-
02053	Trigg Co. Maint. Building	.17	.0010	10/95%	10/96%	1/96%	8.0	-	-
02026	Barkley Lake S.P.	3.00	.0400	3/98%	3/99%	1/96%	8.0	-	-
02076	Barkley Lake S.P.	90.10	.0800	30/87%	30/87%	20/20%	4.0	-	-
02028	Christman Motel	.16	.0021	3/98%	3/99%	1/96%	8.0	-	-
02029	Boat Haven	1.10	.0010	30/87%	30/87%	20/20%	4.0	-	-
02148	Cadiz Water Department	-	-	-	30	-	-	-	-

Alternative Water Quality Management Plans

On the regional level, the Cadiz sewer system could pick up surrounding subdivisions which are presently served by septic tanks, and the industrial park area east of town. When the 201 Facility Plan is complete a more detailed analysis and cost estimate for needs will be available.

According to the 1980 computer modeling, in order to meet the stream standards throughout this segment requiring a D.O. of 5 mg/l, even a small discharger will be required to have T4B treatment with an effluent having BOD = 10 mg/l, SS = 10 mg/l and NH_3-Nitrogen equal to 1 mg/l. This treatment level is extremely expensive and difficult to obtain and is probably not economically feasible for small dischargers on streams where Q7-10 low flows equal zero.

Shady Lawn Nursing Home, with approximately 50 resident patients, discharges 6000 gpd from an extended aeration package plant into an open ditch which enters a nondischarging lagoon. It has been assumed that since this discharge does run approximately 200 feet in a ditch, that a zero low flow condition exists. From the lagoon, the effluent exfiltrates through the karst topography and is assumed to enter the Little River through an underground stream. This discharge, although producing an effluent equal to secondary treatment, will be required to meet tertiary requirements because of the D.O. deficit and NH_3-nitrogen level in the ditch and the underground stream.

To combat this type of uneconomical requirement, water quality standards should be revised to exclude small discharges from requirements greater than secondary treatment. Discharges less than 50,000 gpd perhaps should be those requiring no more than secondary treatment.

SEGMENT #11 ANALYSIS

Classification: Effluent Limited Priority: 3.19

Location

As shown in Exhibit B-11.1m, Segment Basin #11 is located in Trigg and Christian Counties, with a spill-over into the State of Tennessee. The basin contains 91 square miles, and all but 3.3 percent of this land surface is located in Christian County. The largest populated place in the segment is LaFayette (pop. 158). However, approximately one-fifth of the basin consist of Ft. Campbell Military Reservation land.

Basic Planning Data

Segment #11 is projected to add 1,156 persons and 373 housing units, between 1970 and 1995 (see Exh. B-11.2t). Over 500 employment opportunities will be created in this area and population density is expected to increase from 35 persons per square mile in 1970 to 47 persons per square mile in 1995. Urban-related land use, to accommodate rural, non-farm population growth, is projected to increase by 0.26 square miles between 1970 and 1995.

Exh. B-11.2t: Segment #11 Basic Planning Data*[1]

	1970	1975	1980	1995
Population Total	3,182	3,162	3,345	4,338
..Rural	3,182	3,162	3,345	4,338
..Farm	967	961	1,016	1,312
..Non-Farm	2,215	2,201	2,329	3,026
..Urban	0	0	0	0
Population Density ..Persons/sq.mi.	35.00	34.75	36.76	47.70
Housing Units	871	888	965	1,244
..Rural	871	888	965	1,244
..Urban	0	0	0	0
Non-Ag. Employment*[2]	-	-	(215)	(315)
..Manufacturing	-	-	-	-
..Non-Manufacturing	-	-	(215)	(315)
Land Use Total (sq.mi.)	91.00	91.00	91.00	91.00
..Rural	90.38	90.38	90.34	90.12
..Agriculture	90.38	90.38	90.34	90.12
..Silviculture	.00	.00	.00	.00
..Mining	.00	.00	.00	.00
..Construction	-	-	-	-
..Urban-Related	.62	.62	.66	.88

*[1]-for additional information on basic planning data, see Appendix "A".

*[2]-Employment figures in 1980 and 1995 columns are not at-year totals; but, rather are only the projected increase between 1975-80 and 1980-1995.

Segment Hydrology

Segment #11, as shown by Exhibit B-11.1m, lies in southern Trigg and Christian Counties draining 91 square miles of flat to rolling, sinkhole filled land. No major streams exist and drainage for this area flows south and the east in Dry Creek and Dry Fork Creek, both tributary to the Little West Fork Red River in Tennessee. This segment has been classified effluent limited solely on the basis of no significant discharges flowing into these streams in Kentucky which violate water quality standards. All streams in the segment have a Q7-10 of zero.

Water Quality Data

No monitoring stations exist in Segment #11 and water quality is assumed good due to the lack of significent discharges in the area.

Point Source Discharges

No significant point source discharges were found listed for this segment either in state or federal records or the ADD plans. A portion of the Fort Campbell Military Reservation lies in this segment. The main Fort Campbell treatment plant lies in the Tennessee portion of the base. Recent sewage treatment plant upgrading plans call for pumping the plants effluent to the Red River at Clarksville. In the Kentucky part of the base EPA has issued NPDES permits for cooling towers as shown in Exhibit 11.3t. These towers currently discharging to the ground surface will have their effluent routed by sewers to the upgrade treatment plant. Three boiler blowdown sites likewise will discharge to the sewer system.

Non-Point Source Discharges

A total of twenty equipment wash racks at Fort Campbell discharge water and suspended solids to the natural drainage in the area. Volumes of flow or SS concentrations are not available for these sites and they are not considered significant to water quality.

The small community of Oak Grove, just outside the military reservation, consists of many trailer courts and other types of transient housing. Population projections for this area were not attempted due to the transient nature of military personnel. Water is provided by the Oak Grove Water Company. Sewerage disposal is dependent upon septic fields and cesspools.

The small community of Lafayette, a city of the sixth class, has neither a water or sewer system and depends on wells and springs and septic fields as substitutes for these services. No significant water quality problems have surfaced in this area.

LOWER CUMBERLAND RIVER BASIN

EXHIBIT B-11.1m 11 Thru 19

SEGMENT MAP

LEGEND

DISCHARGERS

- M 00 — MAJOR (OVER 1.0 MGD)
- M 00 — PRINCIPAL (LESS THAN 1.0 MGD)
- (M) MUNICIPAL DISCHARGERS
- (D) DOMESTIC DISCHARGERS
- (I) INDUSTRIAL DISCHARGERS
- SW — SOLID WASTE
- MINING RELATED

5 4 3 2 1 0 5

GRAPHIC SCALE IN MILES

Base Data: U. S. Geological Survey

KENTUCKY WATER QUALITY MANAGEMENT PLAN

Prepared for Division of Water Quality
KENTUCKY DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION

G. REYNOLDS WATKINS
CONSULTING ENGINEERS, INC.
Lexington, Bowling Green & Louisville, Kentucky

Scottsburg

Whitehorn Cr

Rosewood

Hopkinsville

FORT CAMPBELL

CLARKSVILLE

13

14

15

16

17

18

19

11

12

D 067

D 057

D 056

D 064

058

M 068

SW

075

I 066

I 055

D 078

062

SW

M 072

M 073

M 071

SW

SW

SW

LOWER CUMBERLAND RIVER BASIN

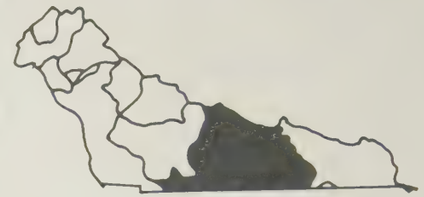


EXHIBIT B-11.1m 11 Thru 19

SEGMENT MAP

LEGEND

DISCHARGERS

- M 00 — MAJOR (OVER 1.0 MGD)
- M 00 — PRINCIPAL (LESS THAN 1.0 MGD)
- (M) MUNICIPAL DISCHARGERS
- (D) DOMESTIC DISCHARGERS
- (I) INDUSTRIAL DISCHARGERS
- SW — SOLID WASTE
- MINING RELATED

5 4 3 2 1 0 5

GRAPHIC SCALE IN MILES

Base Data: U. S. Geological Survey

KENTUCKY WATER QUALITY MANAGEMENT PLAN

Prepared for Division of Water Quality

KENTUCKY DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION

G. REYNOLDS WATKINS CONSULTING ENGINEERS, INC.

Lexington, Bowling Green & Louisville, Kentucky

The rural areas of Christian and Trigg Counties in this segment utilize wells for their water supplies and septic tanks or cesspools most often for sewage waste disposal. Groundwater pollution is not known to be severe in these areas.

Non-point surface water pollution in this segment exists in some degree due to agricultural soil erosion, fertilizer, pesticide, and animal waste runoff during time of heavy rainfall.

Waste Load Allocations and Segment Priority

Segment #11, because of no significant point or non-point discharges, has no waste load allocations and has a segment priority of 3.19 based on population only.

Municipal Needs

Municipal needs in this segment were not computed since the communities located therein have non-point sewage discharges and are not significant in nature. Future growth of the urban communities in this segment could generate groundwater problems, but there is no indication of a serious problem of this nature to date.

Exhibit B-11.3t: Existing Discharge Characteristics (1975)

Code No.	Facility	Location	NPDES Permit No.	Treatment Type	Q7-10 (cfs)	Discharge Characteristics (mg/l)				
						Flow (mgd)	BOD	SS	NH_3	Other
	Ft. Campbell	Drainage ditch Little West Fork Creek	App# KY0021083	--	0	N/A	-	N/A	-	N/A
	Ft. Campbell	Drainage ditch Little West Fork Creek	App# KY0025886	--	0	N/A	-	-	-	N/A

Exhibit B-11.4t: Waste Load Allocations (1980)

Code No.	Facility	Max. Daily Waste Load lb/day	Proposed Effluent Characteristics/Load Reduction						Priority
			Flow (mgd)	BOD (mg/l)	SS (mg/l)	NH_3 (mg/l)	DO (mg/l)	Other	
	Ft. Campbell	-	-	-	-	-	-	-	-
	Ft. Campbell	-	-	-	-	-	-	-	-

SEGMENT #12 ANALYSIS

Classification: Effluent Limited Priority: 1.45

Location

As shown in Exhibit B-11.1m, Segment Basin #12 is located in Christian County. The segment contains 50 square miles of land area surface. There are no large population concentrations in segment #12. Although there is some residential development along state route 107 and U.S. route 41A that are connectors between Hopkinsville and Ft. Campbell.

Basic Planning Data

Segment #12 is projected to add 633 persons and 196 housing units, between 1970 and 1995 (see Exh. B-12.1t). No new employment opportunities are projected within the segment basin. Population density is expected to increase from 29 person per square mile in 1970 to 41 persons per square mile in 1995. Urban-related land use, to accommodate rural non-farm growth, is projected to increase by 0.13 square miles.

Exh. B-12.1t: Segment #12 Basic Planning Data*[1]

	1970	1975	1980	1995
Population Total	1,463	1,452	1,556	2,096
..Rural	1,463	1,452	1,556	2,096
..Farm	439	436	467	629
..Non-Farm	1,024	1,016	1,089	1,467
..Urban	0	0	0	0
Population Density ..Persons/sq.mi.	29.26	29.04	31.12	41.92
Housing Units	387	393	433	583
..Rural	387	393	433	583
..Urban	0	0	0	0
Non-Ag. Employment	-	-	-	-
..Manufacturing	-	-	-	-
..Non-Manufacturing	-	-	-	-
Land Use Total (sq.mi.)	50.00	50.00	50.00	50.00
..Rural	49.71	49.71	49.69	49.58
..Agriculture	49.51	49.51	49.49	49.38
..Silviculture	.00	.00	.00	.00
..Mining	.20	.20	.20	.20
..Construction	-	-	-	-
..Urban-Related	.29	.29	.31	.42

*[1]-for additional information on basic planning data, see Appendix "A".

Segment Hydrology

Segment #12, as shown by Exhibit B-11.1m, includes the Little River and its tributaries from M.P. 48.75 to the confluence of North and South Forks. This portion of Little River drains 50 square miles in central Christian County. Elevations range from 450 ft. to 805 ft. above mean sea level in this rolling, karst topography. Many springs and natural ponds give evidence to the vast underground drainage network in this area. The Q7-10 value for this reach is approximately 8 cfs, a relatively high flow in the LCRB.

Water Quality Data

The only stations on the Little River with data are near Cadiz, downstream from Segment #12. The water quality measured at these points is very good. The absence of recorded point discharges within this area practically insures that no water quality problems exist.

Point Source Discharges

No recorded point source discharges exist within this segment.

Non-Point Source Discharges

Scattered houses along KY 107, Ky 695, and U.S. 41 Alternate, typically use septic tanks for sewage disposal. The relatively low population density in this area minimizes potential ground water pollution and there is no recorded evidence of such pollution in this area.

Waste Load Allocations and Priority

This effluent limited segment has no waste load allocation computed and a priority of only 1.42, calculated from the segment population and probably one of the lowest in the state.

SEGMENT #13 ANALYSIS

Classification: Water Quality Limited

Priority: 1,226.88

Location

As shown by Exhibit B-11.1m, Segment Basin #13 is located in Christian County. The segment includes 60 square miles of land area, of which approximately two-thirds is the city of Hopkinsville (pop. 21,250). The segment is centrally located in the county and several state and federal highways converge there, as well as two railway lines. Four large lakes dot the northern portion of the segment basin.

Basic Planning Data

This segment basin represents one of the highest growth areas in the Lower Cumberland River Basin (see Exh. B-13.1t). Between 1970 and 1995, it is projected that almost four square miles of new urbanized land will be needed to accommodate the increased population growth of almost 14,000 people. Over 4,000 new housing units will be required, and it is projected that over 1,600 new jobs will be created in this area.

Exh. B-13.1t: Segment #13 Basic Planning Data*[1]

	1970	1975	1980	1995
Population Total	22,670	25,355	27,172	36,613
..Rural	1,750	1,736	1,861	2,507
..Farm	525	521	558	752
..Non-Farm	1,225	1,215	1,303	1,755
..Urban	20,920	23,619	25,311	34,106
Population Density ..Persons/sq.mi.	377.83	422.58	452.87	610.22
Housing Units	5,991	6,866	7,567	10,196
..Rural	463	470	517	696
..Urban	5,528	6,396	7,050	9,500
Non-Ag. Employment*[2]	-	-	(599)	(1,021)
..Manufacturing	-	-	(126)	(233)
..Non-Manufacturing	-	-	(473)	(788)
Land Use Total (sq.mi.)	60.00	60.00	60.00	60.00
..Rural	53.78	53.03	52.53	49.93
..Agriculture	53.58	52.83	52.33	49.73
..Silviculture	.00	.00	.00	.00
..Mining	.20	.20	.20	.20
..Construction	-	-	-	-
..Urban-Related	6.22	6.97	7.47	10.07

*[1]-for additional information on basic planning data, see Appendix "A".

*[2]-Employment figures in 1980 and 1995 columns are not at-year totals; but, rather are only the projected increase between 1975-80 and 1980-95.

Segment Hydrology

Segment #13, as shown by Exhibit B-11.1m, includes the North Fork Little River and its tributaries to the headwaters. Tributaries are White Creek including Lake Blythe, Upper Branch including Lake Morris, Middle Branch including Lake Tandy, and Lower Branch including Lake Boxley. This karst area has many small ponds and springs giving some indication of the groundwater conditions in the area. This segment drains 60 square miles in Christian County, six of which are in the urbanized area of Hopkinsville. Q7-10 low flow values for North Fork range from 0 cfs at milepoint 72.0 to 5.2 cfs at the confluence of North and South Forks. These values are estimated from groundwater conditions in the segment. No flow augmentation is available from the upstream lakes according to the preliminary investigation by the 201 Facilities Plan contractor.

Water Quality Data

No monitoring data was available from the STORET system in this segment although several monitoring stations have been proposed for this general area. One site has been proposed on the Little River at the Hopkinsville Water Plant Intake milepoint 74.0. Another proposed station is at Little River milepoint 53.8 below the confluence of North and South Forks. The nearest station with data was on Little River above Cadiz. Data here shows no abnormal concentrations of acids or solids and had a recorded flow value of 618 cfs, as shown in Exhibit A-1.1t, Appendix A. The overall water quality of segment 13 is marginal with the water quality in North Fork exhibiting a dissolved oxygen deficit from milepoint 71.3 below the Hopkinsville STP to milepoint 61.9 above the North and South Fork confluence, resulting in a Water Quality Limited classification for this segment. These water quality judgements were made from estimates of upstream water quality and from the 1980 computer model assuming secondary treatment efficiencies for all of this segment's point discharges.

Point Source Discharges

Eight individual point source discharges are located in segment 13 as shown in Exhibit B-13.2t. These include five domestic and two industrial discharges and one sewage treatment plant in Hopkinsville.

The Hopkinsville STP is a trickling filter type with primary and secondary classification, anaerobic sludge digestion, and sludge drying beds. The facility

is capable of treating 3.0 MGD but, in wet weather, has to by-pass flow above that without treatment. The present plant is operating at a loaded efficiency of 70%-80% removal for BOD and SS.

Edgewood Church, Parklawn Nursing Home, and the Duerson Home are all in an area presently being sewered by Hopkinsville. These dischargers can be expected to connect to the city system sometime this autumn.

Thomas Industries discharges industrial waste from their plant on North Fork. This plant assembles lighting fixtures and is permitted to discharge cyanide, copper, zinc, and BOD_5 and suspended solids from an outfall located at the junction of T Avenue and West 16th Street in Hopkinsville.

Hopkinsville Independent Schools has a permit application to discharge into North Fork through a 2500 gpd extended aeration plant. The other light discharger, North Hopkinsville Toll Plaza, has a flow of 300 gpd and discharges waste from an extended aeration plant to White Creek. The Texaco, Inc. has a permit to discharge oil and grease with storm water and waste water from bulk storage tank areas, product transfer areas and unloading areas. This effluent source is at 14th and Clay Streets in Hopkinsville.

Non-Point Source Discharges

Since segment 13 has an urban population greater than 10,000, it has been declared a significant source of urban runoff. No other significant non-point sources exist in this segment which materially affect water quality. Agriculturally related non-point sources of pollution occur to some degree in this segment with fertilizers, pesticides, silt and animal waste being carried to surface streams and underground solution channels during periods of heavy rainfall.

Waste Load Allocations and Priority

Waste load allocations for this water quality limited segment are shown in Exhibit B-13.3t. These allocations are based on the estimated flow and proposed treatment for 1980 for each discharge.

The major discharge, Hopkinsville STP, has a proposed treatment of T4B for 1980, with a waste load allocation of 704 lbs BOD/day at a flow of 3.0 MGD. This treatment level was calculated from the 1980 computer model to meet the dissolved oxygen and ammonia requirements of Little River in segment 13. The other allocations are minimal in comparison, as shown by this exhibit. The segment priority is 1226.9, calculated from the existing and required treatment levels. This is the highest priority in the LCRB and has a high statewide ranking.

Municipal Needs

The Pennyrile Area Development District Plan proposed in 1972 that Hopkinsville build a new plant equal in capacity to the old plant. According to preliminary plans from the Hopkinsville 201 planning team, this plant should discharge at the confluence of the North and South Forks of Little River. Q7-10 low flow below the confluence is estimated at 7 cfs. The needs for Hopkinsville include upgrading the existing plant to meet the proposed 1980 standards,

Exhibit B-13.2t: Existing Discharge Characteristics (1975)

Code No.	Facility	Location	NPDES Permit No.	Treatment Type	Q7-10 (cfs)	Discharge Characteristics (mg/1)				
						Flow (mgd)	BOD	SS	NH_3	Other
02065	Hopkinsville Industrial School	N/A	App# KY0026689	Extended Aeration (E.A.)	0	.0025	15	20	2	--
02066	Thomas Industries	59.0/72.9/0.3	KY0003565	Industrial	0	.0864	-	-	-	--
02067	N. Hopkinsville Toll Plaza	White Creek 59.0/76.0	---	E.A.	0	.0003	15	20	2	--
02068	Hopkinsville STP	N. Fk. Little 59.0/71.6	KY0023388	Trickling Filter	0.23	3.9365	40	23	1	--
02166	Texaco, Inc.	N/A	KY0021768	Industrial	N/A	N/A	-	N/A	-	Oil & Grease 15mg/1
02059	Edgewood Church	U.T.-N. Fk. Little River 59.0/72.1/0.7	KY0024741	E.A.	0	.0080	15	20	2	--
02060	Duerson Home	U.T.-N.K. Little River 59.0/72.1/0.7	---	Settling Tank w/ Sand Filter (S.T. - S.F.)	0	.0021	40	100	1	--
02064	Parklawn Nursing Home	U.T.-N. Fk. Little River 59.0/72.1/0.7/ 1.0	---	S.T. - S.F.	0	.018	40	100	1	--

building the new plant, building new interceptors (projected for 1995), and building new collectors (projected for 1980). These needs and estimated 1975 costs are shown in Exhibit B-13.4t.

Exhibit B-13.4t: Municipal Needs

Code Number	Facility	1980/1995 Treatment Needs	Cost Millions	Compliance Goal
02068	Hopkinsville	T4B/T4B	37.3	7/1/77
		T	9.6	
		I	10.5	
		C	13.5	
		I/I	3.7	

No alternatives are available for solving the urban non-point source runoff at the present time. Further study is needed by state and federal agencies to solve the non-point source problems in the LCRB.

Alternative Water Quality Management Plans

Most of the discharges in segments 13 and 14 lie in or near Hopkinsville. These smaller dischargers could possibly be added to the Hopkinsville sewer system and thus solve their treatment problems. In places where sewer connection is impossible or economically unfeasible, small package plants with filtration and chlorination will probably be acceptable for meeting the 1980 proposed standards.

No water management plans have been done in this area since the Soil Conservation Service Plan in 1960 for flood protection and watershed protection for North Fork of Little River. This plan proposed two of the lakes now in existence, Lake Blythe and Lake Boxley.

In this segment no alternative to T4B treatment is available. This fact in itself calls for a more detailed analysis such as the 201 Plan might provide to determine the most cost effective means of treating and discharging Hopkinsville's municipal waste. Further study need also be given to the small discharges on these zero Q7-10 low flow streams and the economic hardship placed on them to achieve T4B treatment levels. A benefit cost analysis of the streams affected by these small discharges should be made to determine if secondary treatment will suffice as a practical treatment requirement for discharges under some flow level such as 50,000 gpd.

Exhibit B-13.3t: Waste Load Allocations (1980)

Code No.	Facility	Max. Daily Waste Load lb/day	Proposed Effluent Characteristics/Load Reduction						Priority
			Flow (mgd)	BOD (mg/l)	SS (mg/l)	NH_3 (mg/l)	DO (mg/l)	Other	
02065	Hopkinsville Industrial School	0.42	.0025	10/95%	10/95%	1.0/96%	8.0	-	
02066	Thomas Industries	-	.0864	-	-	-	-	-	
02067	N. Hopkinsville Toll Plaza	0.33	.0003	10/95%	10/95%	1.0/96%	8.0	-	
02068	Hopkinsville STP	703.73	4.2185	10/95%	10/95%	1.0/96%	8.0	-	1367.7
02166	Texaco, Inc.	-	N/A	N/A	N/A	N/A	N/A	15 mg/l Oil & Grease	-
02060	Duerson Home	2.36	.0021	30/67%	30/67%	20/20%	4.0	-	-
02064	Parklawn Nursing Home	3.00	.0180	10/95%	10/95%	1/96%	8.0	-	-

SEGMENT #14 ANALYSIS

Classification: Water Quality Limited

Priority: 24.56

Location

As shown in Exhibit B-11.1m, Segment Basin #14 is located in Todd and Christian Counties, although only 2.4 percent of the segment is located in Todd County. Most of the land area (97.6 percent) is in Christian County and includes one-third of the city of Hopkinsville (pop. 21,250).

Basic Planning Data

Segment #14 is a rapidly growing area that will need to add 2.6 square miles of urbanized land to support future growth of 9,634 persons and 2,909 new housing units, between 1970 and 1995. Over 11,000 new jobs are projected between 1975 and 1995. Population density is expected to increase from 235 persons per square mile in 1970 to 378 persons per square mile in 1995. (see Exhibit B-14.1t)

Exh. B-14.1t: Segment #14 Basic Planning Data*[1]

	1970	1975	1980	1995
Population Total	15,930	17,715	18,981	25,564
..Rural	1,984	1,969	2,107	2,827
..Farm	596	592	633	850
..Non-Farm	1,388	1,377	1,474	1,977
..Urban	13,946	15,746	16,874	22,737
Population Density ..Persons/sq.mi.	235.65	262.05	280.78	378.16
Housing Units	4,212	4,799	5,288	7,121
..Rural	526	535	588	788
..Urban	3,686	4,264	4,700	6,333
Non-Ag. Employment*[2]	-	-	(4,891)	(6,996)
..Manufacturing	-	-	(2,148)	(2,594)
..Non-Manufacturing	-	-	(2,743)	(4,402)
Land Use Total (sq.mi.)	67.60	67.60	67.60	67.60
..Rural	63.28	62.77	62.43	60.64
..Agriculture	63.08	62.57	62.23	60.44
..Silviculture	.00	.00	.00	.00
..Mining	.20	.20	.20	.20
..Construction	-	-	--	-
..Urban-Related	4.32	4.83	5.17	6.96

*[1]-for additional information on basic planning data, see Appendix "A".

*[2]-Employment figures in 1980 and 1995 columns are not at-year totals; but, rather are only the projected increase between 1975-80 and 1980-95.

Segment Hydrology

Segment #14, as shown by Exhibit B-11.1m, consists of the South Fork Little River and its tributaries in Christian and a small part of Todd County. This stream drains 68 square miles including 5 square miles of urbanized area in and near Hopkinsville. This area is flat to rolling topography and lies in a karst sinkhole region. Numerous small springs and ponds are evidence of the high groundwater table throughout the segment. Rock Bridge Branch and Warren's Fork are the only named tributaries to the South Fork. Estimated Q7-10 low flow values for South Fork range from 0 cfs at milepoint 17.0 to 2.7 cfs at the confluence of North and South Forks of Little River at milepoint 61.0 on the Little River.

Water Quality Data

No monitoring data was available from the STORET system in this segment although several monitoring stations have been proposed for this general area. One site has been proposed on the Little River at the Hopkinsville Water Plant Intake milepoint 74.0 North Fork Little River. Another proposed station is at Little River milepoint 53.8 below the confluence of North and South Forks. The nearest station with data is on Little River above Cadiz. Data here shows no abnormal concentrations of acids or solids and had a recorded flow value of 618 cfs, as shown in Exhibit A-1.1t, Appendix A. The overall water quality is marginal in the South Fork due to sanitary discharges flowing into the stream from the southeastern portion of Hopkinsville. Dissolved oxygen deficits in the South Fork result in this segment being Water Quality Limited.

Point Source Discharges

Exhibit B-14.2t lists nine discharges which flow into the South Fork drainage system and their existing characteristics. Five of these are industrial dischargers which allow only cooling water or industrial wastes to flow from lagoons or other treatment facilities to the drainage system.

The Phelps Dodge Company and the W.K. Grace Company both discharge only cooling water. No actual temperature data was available; however, the Phelps Dodge plant has an NPDES permit allowing them to discharge 400 gallons per day cooling water to an unnamed tributary of South Fork. The W.K. Grace Company discharges cooling water into the river at milepoint 7.3.

Phelps Dodge and the Phillips Products Company discharge industrial wastes to lagoons which have no direct discharge point. These are assumed to discharge to the drainage system of South Fork due to the under-

ground drainage evident in the area. The USM Company discharges industrial wastewater containing aluminum and total suspended solids from the process of cleaning and etching blind rivets to a ditch flowing to an unnamed tributary of South Fork.

The Western State Hospital has a trickling filter plant with a capacity of 300,000 gpd discharging into an unnamed tributary to South Fork which flows into the river near the Hopkinsville-Christian County Airport. The Humphrey Photo Studio is scheduled to go on the sewer system this year and abandon its settling tank with sand filter. Combs Hogs is a feedlot operation discharging waste into a nondischarging lagoon. The Meadow Brook Trailer Park treats sanitary sewage from 60-70 mobile homes in a 9000 gpd extended aeration package plant. This discharge lies on the same tributary as the Phelps Dodge discharge.

Non-Point Source Discharges

Several quarries exist in this area which could possibly cause suspended solids problems in the water during high runoff. Scattered houses throughout the segment and some strip housing on the outskirts of Hopkinsville use septic fields for waste disposal. These areas are not considered highly influential on water quality in the area. Segment 14 has been declared a significant non-point source area due to the urban runoff from the metropolitan and industrialized areas. Guide lines for this urban classification were that any segment having a municipality with greater than 10,000 population should be classified as having urban runoff non-point source problems. This classification adds 100 points to the segment priority.

Agricultural operations in this segment contribute non-point wastes during times of heavy rainfall such as pesticides, silt, fertilizer, and animal wastes. This agricultural runoff affects the streams to some extent and readily enters the groundwater through the sinkholes which are prevalent in this area. This non-point pollution is not considered significant and is much diluted during these high runoff periods.

Waste Load Allocation and Priority

Waste load allocations for segment 14 are set based on the treatment levels required by the 1980 computer model. These values represent the maximum allowable daily discharge loads for the estimated 1980 flow values, as shown in Exhibit B-14.3t. This segment classified Effluent Limited, has a low state wide ranking of 140.8. The Hopkinsville municipal discharge lies in segment 13 and therefore, the municipal needs for Hopkinsville are presented in total in the Segment 13 Analysis of this Appendix.

The 1980 computer model predicted a dissolved oxygen deficit from milepoint 9.6 to milepoint 5.7 on the South Fork. The Western State Hospital plant discharges at milepoint 10.3 with a capacity flow of 300,000 gpd. This discharge, when flowing into the Q7-10 low flow estimated value of 1.14 cfs, would require T1A, or secondary treatment to meet the 1980 allocations. With proper operation this plant could discharge the proposed effluent with little expense.

Meadow Brook Trailer Park, discharging into an unnamed tributary, will need to upgrade its facility to meet the more strict T4B standards. The 1980 computer

Exhibit B-14.2t: Existing Discharge Characteristics (1975)

Code No.	Facility	Location	NPDES Permit No.	Treatment Type	Q7-10 (cfs)	Discharge Characteristics (mg/l)				
						Flow (mgd)	BOD	SS	NH_3	Other
02055	U.S. Machine	59.0/61.0/3.8/ 1.1/1.7	KY0003786	Industrial	0	.0600	-	32	-	--
02056	Hopkinsville-Christian Co. Airport	59.0/61.0/10.3	---	Settling Tank w/ Sand Filter	0	.0600	40	100	1	--
02057	Western State Hospital	59.0/61.0/10.5	---	Trickling Filter	1.14	.0300	74	25	1	--
02058	W. K. Grace	59.0/61.0/7.3/ 1.2	---	Cooling H_2O	1.55	.0021	-	-	-	--
02061	Combs Hog Parlor	N/A	---	Non-Discharge Lagoon	N/A	.0022	40	100	1	--
02062	Phelps Dodge	U.T.-S.F. Little River - 59.0/ 61.0/3.8/3.0	KY0003573	Cooling H_2O No Discharge	0	.0004	-	-	-	--
02063	Humphrey Photo Studio	N/A	---	Settling Tank w/ Sand Filter	N/A	.0021	40	100	1	--
02164	Phillips Products	U.T.-S.F. Little River - 59.0/ 61.0/6.6/1.2	---	Lagoon	N/A	N/A	N/A	N/A	N/A	--
02077	Meadow Brook Trailer Park	59.0/61.0/3.8 2.5	---	Extended Aeration	0	.0090	15	20	2	--

model predicted a dissolved oxygen deficit in this stream between milepoints 0.4 and 1.10. This situation will need a more detailed analysis to determine the most cost effective means of correction. This level of detail will be achieved by the 201 Facilities Plan.

Municipal Needs

Municipal needs for Hopkinsville are included in the Segment 13 analysis. For purposes of computing the facility priority, the segment priorities of segment 13 and 14 were added to get a more realistic segment priority for the Hopkinsville area.

Alternative Water Quality Management Plans

The Pennyrile Area Development District Plan recommended (1972) that Hopkinsville build another plant equal in capacity to the existing facility. This plant would assume half the Hopkinsville load and thus improve effluent quality. A detailed study is being prepared in the 201 Facilities Plan presently being prepared and should be available late this year.

Exhibit B-14.3t: Waste Load Allocations (1980)

Code No.	Facility	Max. Daily Waste Load lb/day	Proposed Effluent Characteristics/Load Reduction						Priority
			Flow (mgd)	BOD (mg/l)	SS (mg/l)	NH_3 (mg/l)	DO (mg/l)	Other	
02055	U.S. Machine	10.84	.0600	10/95%	10/96%	1/96%	8.0	-	-
02056	Hopkinsville-Christian County Airport	7.92	.0600	10/95%	10/96%	1/96%	8.0	-	-
02057	Western State Hosp.	33.78	.0300	30/67%	30/87%	20/20%	4.0	-	-
02058	W.K. Grace	-	.0021	-	-	-			
02061	Combs Hog Parlor	N.D.	.0022	30/67%	30/87%	20/20%	4.0	-	-
02062	Phelps Dodge	N.D.	.0004	-	-	-			
02063	Humphrey Photo Studio	2.36	.0021	30/67%	30/87%	20/20%	4.0	-	-
02077	Meadow Brook Trailer Park	1.5	.0090	10/95%	10/96%	1/95%	8.0	-	-
02164	Phillips Products - Ind. - N.D. -								

SEGMENT #15 ANALYSIS

Classification: Water Quality Limited

Priority: 0.58

Location

As shown in Exhibit B-11.1m, Segment Basin #15 is located in Christian and Todd Counties. The land area total for the segment is 19.8 square miles. All but 4 percent of the land area is located in Christian County. The western portion of the segment adjoins Ft. Campbell Military Reservation and there is considerable commercial and residential development.

Basic Planning Data

As shown by Exhibit B-15.1t, Segment #15 is projected to add 244 persons between 1970 and 1995. This increased population will require an additional 76 housing units. No new job opportunities are projected for this segment. Population density is projected to increase from 29 to almost 42 people per square mile. Urban-related land use (as reflected by non-farm rural population) is projected to increase by 0.05 square miles.

Exh. B-15.1t: Segment #15 Basic Planning Data*[1]

	1970	1975	1980	1995
Population Total	582	578	618	826
..Rural	582	578	618	826
..Farm	175	174	186	249
..Non-Farm	407	404	432	577
..Urban	0	0	0	0
Population Density ..Persons/sq.mi.	29.39	29.19	31.16	41.72
Housing Units	255	158	173	231
..Rural	255	158	173	231
..Urban	0	0	0	0
Non-Ag. Employment	-	-	-	-
..Manufacturing	-	-	-	-
..Non-Manufacturing	-	-	-	-
Land Use Total (sq.mi.)	19.80	19.80	19.80	19.80
..Rural	19.69	19.69	19.68	19.64
..Agriculture	19.69	19.69	19.68	19.64
..Silviculture	.00	.00	.00	.00
..Mining	.00	.00	.00	.00
..Construction	-	-	-	-
..Urban-Related	.11	.11	.12	.16

*[1]-for additional information on basic planning data, see Appendix "A".

Segment Hydrology

Segment #15, as shown by Exhibit B-11.1m, drains approximately 20 square miles in southern Christian and Todd Counties. This karst region includes as its main stream the Big West Fork of Red River from the Kentucky-Tennessee state line at M.P. 14.5 to near the confluence of Montgomery Creek at M.P. 26.3. All minor tributaries in this flat to rolling region are intermittent or flow underground. The Big West Fork Q7-10 ranges from 1.9 cfs at the Montgomery Creek confluence to 2.5 cfs at the state line.

Water Quality Data

No monitor data was available for this segment. Water quality, however, has been estimated by the computer model to be poor due to the effluent loading from Pembroke STP in Segment #16 and Trenton STP in Segment #17. The 1980 computer model predicts a D.O. deficit from M.P. 22.03 to the segment end at M.P. 26.3 - a total of 4.2 miles.

Point Source Discharges

No point source discharges have been identified in Segment #15 in state or local records.

Non-Point Source Discharges

Septic fields tend to be the only non-point source in this area and these are not considered significant. St. Elmo, Hensleytown, and Barkers Mill all rely on wells for water and septic fields for domestic sewage disposal. No significant problems are presently evident in their ground water quality.

Agricultural pollutants such as silt, fertilizer, pesticide and animal waste runoff in times of heavy rainfall are the primary non-point pollutants in this segment, but are not considered significant.

Waste Load Allocations and Segment Priority

Waste load allocations are not computed since no point sources exist. The segment priority of 0.58 is computed solely from the segment population.

SEGMENT #16 ANALYSIS

Classification: Water Quality Limited

Priority: 20.82

Location

As seen in Exhibit B-11.1m, Segment Basin #16 is located in Christian and Todd Counties. Like segment #15, most (97.5 percent) of the land area is in Christian County with two very small land parcels in Todd County. The largest populated place in the segment is the city of Pembroke (pop. 634).

Basic Planning Data

Segment #16 is projected to add 415 persons, and 130 housing units, between 1970 and 1995 (see Exh. B-16.1t). No new employment opportunities are projected within the segment basin. Population density is expected to increase from 30 persons per square mile in 1970 to 43 persons per square mile in 1995. Urban-related land use is projected to increase by 0.08 square miles in order to accommodate rural non-farm population growth.

Exh. B-16.1t: Segment #16 Basic Planning Data*[1]

	1970	1975	1980	1995
Population Total	979	972	1,040	1,394
..Rural	979	972	1,040	1,394
..Farm	294	292	312	419
..Non-Farm	685	680	728	975
..Urban	0	0	0	0
Population Density ..Persons/sq.mi.	30.59	30.38	32.50	43.56
Housing Units	260	264	291	390
..Rural	260	264	291	390
..Urban	0	0	0	0
Non-Ag. Employment	-	-	-	-
..Manufacturing	-	-	-	-
..Non-Manufacturing	-	-	-	-
Land Use Total (sq.mi.)	32.00	32.00	32.00	32.00
..Rural	31.81	31.81	31.80	31.73
..Agriculture	31.81	31.81	31.80	31.73
..Silviculture	.00	.00	.00	.00
..Mining	.00	.00	.00	.00
..Construction	-	-	-	-
..Urban-Related	.19	.19	.20	.27

*[1]-for additional information on basic planning data, see Appendix "A".

Segment Hydrology

Segment 16, as shown by Exhibit B-11.1m, includes Montgomery Creek from its confluence with West Fork to the headwaters. Q7-10 low-flows ranges from 0 cfs upstream to 0.8 cfs at the mouth of the creek. This segment contains 32 square miles of hilly land ranging from 460 feet to 675 feet in elevation. The area is karst and sinkholes are prevalent near the creek and its tributaries.

Water Quality Data

No water quality stations exist in this segment. Using assumed upstream water quality data, the 1980 computer model predicted a D.O deficit from M.P. 5.4 to M.P. 0 due to the effluent loading from Pembroke STP thus resulting in the segment classification as Water Quality.

Point Source Discharges

The only discharge in this segment is Pembroke STP at M.P. 3.1 on Montgomery Creek. This plant uses a contact stabilization process capable of treating 70,000 gpd effluent. Existing discharge characteristics were estimated from normal removal efficiencies for this type of facility and are listed in Exhibit B-16.2t. Average flow through the plant based on population is 68,000 gpd.

Non-Point Source Discharges

Developments around Pembroke in rural areas depend on septic tanks and leaching fields for sewage disposal but have created no significant ground water quality problems. Some agricultural non-point runoff occurs in this segment and contains silt, pesticides, fertilizers, and animal wastes. This runoff can affect ground water more readily due to the sinkholes in this karst topography.

Waste Load Allocations and Priority

Since Montgomery Creek has Q7-10 low-flow equal to zero, the Pembroke plant proposed treatment is tertiary with effluent standards as shown in Exhibit B-16.3t. At the 1980 projected flow rate of 73,200 gpd, the plant will produce 12.18 lbs BOD/day. The segment priority is 20.82, a low statewide ranking. The facility priority for Pembroke, calculated using the municipal needs costs, is 44.7.

Municipal Needs

To meet the 1980 proposed standards as determined by the computer model, the Pembroke plant will need to provide T4B treatment as shown in Exhibit B-16.4t. Presently, the 70,000 gpd extended aeration plant is handling the flow rate. Predicted flow for 1995 is 98,600 cfs. This increased flow will necessitate plant expansion to 100,000 gpd plus the addition of mixed media filtration to meet the 1980 proposed standards. The total cost of this expansion and upgrading is $85,674 for 1975.

Interceptor sewer needs for 1995 are 5000 feet at a total 1975 cost of $163,500. Collector needs projected for 1980 are 5100 feet at a 1975 cost of $123,000.

Exhibit B-16.2t: Existing Discharge Characteristics (1975)

Code No.	Facility	Location	NPDES Permit No.	Treatment Type	Q7-10 (cfs)	Discharge Characteristics (mg/l) Flow (mgd)	BOD	SS	NH_3	Other
02072	Pembroke STP	U.T.- Montgomery Creek - Red River 125.3/1.4/26.4/ 3.7/3.1	KY0024813	Contact Stabilization	0	.0683	15	20	20	--

Exhibit B-16.3t: Waste Load Allocations (1980)

Code No.	Facility	Max. Daily Waste Load lb/day	Proposed Effluent Characteristics/Load Reduction Flow (mgd)	BOD (mg/l)	SS (mg/l)	NH_3 (mg/l)	DO (mg/l)	Other	Priority
02072	Pembroke STP	12.8	.0732	10/95%	10/96%	1.0/96%	8.0	-	44.7

Exhibit B-16.4t: Municipal Needs

Code Number	Facility	1980/1995 Treatment Needs	Cost Million	Compliance Date
02072	Pembroke STP Priority 44.7	T4B/T4B T C I I/I	.086 .123 .164 .066	7/1/77

Infiltration to the Pembroke sewage system is excessive requiring analysis and correction at an estimated cost of $66,000.

With the addition of these needs, the Pembroke plant should discharge an effluent acceptable to the 1980 and 1995 requirements and have a capacity to serve the projected 1995 population.

Alternative Water Quality Management Plans

The only feasible alternative to treatment considered was pumping approximately 6 miles to the West Fork of Red River. This alternate requires 18,000 feet of force main at $144,000, a 150 gpm pump station at $47,000, and operation and maintenance costs of $7,000 for twenty years. Total alternative cost was $198,000, more than twice the cost of upgrading the treatment facility.

The possibility of land application of secondary effluent was considered and found unfeasible due to the karst topography and poor suitability of land in this area for waste disposal which would seriously endanger ground water quality in this segment.

The possibility of pumping to another facility for less costly treatment was ruled out since no others are available.

The Pembroke area has been designated as a 201 planning area and a more detailed analysis of needs and costs should be available when the facilities plan is complete.

The non-point source problem (septic tanks) will essentially be solved in this area with the addition of new interceptors and collectors projected for 1980 and 1995.

SEGMENT #17 ANALYSIS

Classification: Water Quality Limited

Priority: 13.15

Location

As shown in Exhibit B-11.1m, Segment Basin #17 is located in Christian and Todd County. The total surface land area is 75.8 square miles. Most of this area (94 percent) is located in Todd County. The remainder is divided among three small land parcels which jut into Christian County. The only large concentration of people within the segment is in Trenton (pop. 496).

Basic Planning Data

Segment #17 is projected to increase by 62 housing units and by 130 persons between 1970 and 1995 (see Exh. B-17.1t). No new employment opportunities are projected within the segment basin. Population density is expected to increase from 28 persons per square mile in 1970 to 30 persons per square mile in 1995. Urban-related land use is projected to increase by 0.02 square miles.

Exh. B-17.1t: Segment #17 Basic Planning Data*[1]

	1970	1975	1980	1995
Population Total	2,138	2,137	2,143	2,268
..Rural	2,138	2,137	2,143	2,268
..Farm	718	717	719	759
..Non-Farm	1,420	1,420	1,424	1,509
..Urban	0	0	0	0
Population Density ..Persons/sq.mi.	28.20	28.20	28.30	30.00
Housing Units	685	686	709	747
..Rural	685	686	709	747
..Urban	0	0	0	0
Non-Ag. Employment	-	-	-	-
..Manufacturing	-	-	-	-
..Non-Manufacturing	-	-	-	-
Land Use Total (sq.mi.)	75.75	75.75	75.75	75.75
..Rural	75.35	75.35	75.35	75.33
..Agriculture	75.35	75.35	75.35	73.33
..Silviculture	.00	.00	.00	.00
..Mining	.00	.00	.00	.00
..Construction	-	-	-	-
..Urban-Related	.40	.40	.40	.42

*[1]-for additional information on basic planning data, see Appendix "A".

Segment Hydrology

The karst topography of segment 17 is typical for southern Christian and Todd counties. This segment drains 48 square miles to the main stem of the Big West Fork Red River beginning above the confluence with Montgomery Creek and including the headwaters as shown in Exhibit B-11.1m. Q7-10 low-flows for this segment ranges from 0 cfs at M.P. 36 to 1.2 cfs at the Montgomery Creek confluence, M.P. 26.4.

Water Quality Data

No monitoring stations with data exist in this segment from which water quality can be evaluated. Assumed water quality values have been used in the 1975 and 1980 computer modeling to predict the waste load effects on the streams. These models predict a D.O. deficit in the Big West Fork from M.P. 29.3 to M.P. 26.4 in segment 17 and farther down to M.P. 22.1 in segment 15. Trenton STP effluent, entering the stream at M.P.29.3 is the primary cause of segment 17 problems. These low dissolved oxygen levels cause this segment to be Water Quality Limited. The water quality in segment 15 is caused by combinations of the effluents to segment 16--Montgomery Creek, and segment 17.

Ground water quality is assumed good due to the low population densities in this segment that contribute to septic tank waste disposal.

Point Source Discharges

As shown in Exhibit B-17.2t with their discharge characteristics, Trenton STP is one of two point source discharges recorded in this segment. This plant with a capacity of 125,000 gpd and an average daily flow of 49,000 gpd, is an extended aeration facility discharging to an intermittant stream known locally as Bluehole Creek. This creek runs into a sinkhole and runs underground to Big West Fork. This underground system is the same general area as Reins Lick Creek which also flows underground north of Trenton.

The Kentucky Stone Company operates a quarry about 4 1/2 miles west of Elkton on US 68. This plant has been issued an NPDES permit to discharge waste water with suspended solids into an unnamed tributary of Big West Fork. No average daily flows are available.

Non-Point Source Discharges

Some of the non-point sources in the segment are those generated by small groupings of houses on septic fields. Fairview is the only other community besides Trenton in the segment. This rural population uses septic fields as their means for sewage disposal and depends largely upon wells for their water supply which should be monitored regularly for septic waste contamination.

Some non-point waste is generated in this segment by farms which contribute fertilizers, silt, pesticides and animal waste runoff during periods of heavy rainfall. This agricultural runoff can affect water quality in the area more readily due to the karst topography of the area containing many sinkholes and solution cavities.

Waste Load Allocation and Priority

Exhibit B-17.3t shows the proposed waste load allocation and effluent characteristics for the Trenton plant for 1980. These limitations will allow the plant effluent to meet water quality standards in Bluehole Creek as well as Big West Fork. The segment priority was calculated from population and waste characteristics and is 13.15, a very low statewide ranking for a water quality limited segment. The facility discharge priority was calculated from the municipal needs presented in Exhibit B-17.5t.

Exhibit B-17.4t: Municipal Needs

Code Number	Facility	1980/1995 Treatment Needs	Cost Million	Compliance Date
02073	Trenton STP Priority 59.2	T4B/T4B T	0.066	7/1/77

Alternative Water Quality Management Plans

The only feasible alternative considered for Trenton was to use the existing level of treatment (T1A) and pump the effluent to West Fork of Red River approximately 1 1/2 miles distant. Cost of a pump station, pump operation, and 8000 feet of force mains is approximately $118,000. This figure is greater than twice the cost of upgrading the treatment facility.

Other alternatives rejected were land disposal of secondary treatment due to poor soil suitability and karst topography; pumping to another larger treatment facility for less expensive treatment rejected because of none available.

The Trenton area has been designated as a 201 planning area. The depth of study should include a more detailed needs survey and cost estimate with the possibilities of adding even more alternatives. Should the community of Fairview be provided with water service, a package plant solution for sewerage might be considered as a feasible alternative.

Exhibit B-17.2t: Existing Discharge Characteristics (1975)

Code No.	Facility	Location	NPDES Permit No.	Treatment Type	Q7-10 (cfs)	Discharge Characteristics (mg/l) Flow (mgd)	BOD	SS	NH_3	Other
02073	Trenton STP	West Fork Red R. 125.3/1.4/29.3/ 1.4/0.3	---	Extended Aeration	0.96	.0493	9	20	2	--
02081	Ky. Stone Co.	West Fork Red R.	KY0003689	Lagoon	0	-	-	N/A	-	--

Exhibit B-17.3t: Waste Load Allocations (1980)

Code No.	Facility	Max. Daily Waste Load lb/day	Proposed Effluent Characteristics/Load Reduction Flow (mgd)	BOD (mg/l)	SS (mg/l)	NH_3 (mg/l)	DO (mg/l)	Other	Priority
02073	Trenton STP	8.34	.0490	10/95%	10/96%	1.0/96%	8.0	-	59.2
02081	Ky. Stone Co.	N/A	N/A	-	55	-	-	-	-

Municipal Needs

The present Trenton plant is a package extended aeration plant which began operation in 1969. Average daily flow is 49,000 gpd and this is not expected to increase in the next twenty years based on population projections for Trenton. The proposed 1980 treatment level, T4B from the computer modeling, will require the addition of mixed media filtration, an aeration ladder, and sludge drying beds. These additions can be made at a 1975 cost of $66,000 broken down as shown in Exhibit B-17.4t. No collector or interceptor needs are projected for this slowly growing community. The discharge priority calculated from the treatment needs costs is 59.2.

SEGMENT #18 ANALYSIS

Classification: Effluent Limited

Priority: 1.45

Location

As shown in Exhibit B-11.1m, Segment Basin #18 is located in Todd and Christian Counties. The total land area of the segment is 49.1 square miles. Only 3 percent of this area is situated within Christian County, with the remaining 97 percent in Todd County. The only large population center of the segment is Guthrie (pop. 1200).

Basic Planning Data

Segment #18 is projected to add 76 persons and 41 housing units between 1970 and 1995 (see Exh. B-18.1t). Over 190 new employment opportunities are projected within the segment. Population density is expected to increase from 30 persons per square mile in 1970 to 31 persons per square mile in 1995. Urban-related land use is projected to increase by 0.01 square miles.

Exh. B-18.1t: Segment #18 Basic Planning Data*[1]

	1970	1975	1980	1995
Population Total	1,449	1,449	1,452	1,525
..Rural	1,449	1,449	1,452	1,525
..Farm	463	463	464	488
..Non-Farm	986	986	988	1,037
..Urban	0	0	0	0
Population Density ..Persons/sq.mi.	30.00	30.00	30.00	31.06
Housing Units	465	466	481	506
..Rural	465	466	481	506
..Urban	0	0	0	0
Non-Ag. Employment*[2]	-	-	(134)	(192)
..Manufacturing	-	-	(83)	(80)
..Non-Manufacturing	-	-	(51)	(112)
Land Use Total (sq.mi.)	49.05	49.05	49.05	49.05
..Rural	48.77	48.77	48.77	48.76
..Agriculture	48.77	48.77	48.77	48.76
..Silviculture	.00	.00	.00	.00
..Mining	.00	.00	.00	.00
..Construction	-	-	-	-
..Urban-Related	.28	.28	.28	.29

*[1]-for additional information on basic planning data, see Appendix "A".

*[2]-Employment figures in 1980 and 1995 columns are not at-year totals; but, rather are only the projected increase between 1975-80 and 1980-95.

Segment Hydrology

Segment 18 drains 77 square miles in southern Christian and Todd Counties. The greatest part of this drainage flows underground due to the karst rolling topography. Many small springs and wells provide water to rural residents. Spring Creek entering the state near Guthrie, is the only stream with Q7-10 low-flow greater than zero in the segment.

Water Quality Data

A monitoring station at Town Spring, also known as Merriweather Spring, in Guthrie, Kentucky, indicates the water quality to be very good in segment 18. With a flow of 0.5 cfs and water temperature 58° F., the spring supplies water for Guthrie. This water exhibits a high hardness level, neutral pH, and a low (background level) dissolved solids level. The nitrate level is greater than values throughout the rest of the LCRB, but the overall water quality seems to be good. Water quality data is presented in Appendix A-1.

Point Source Discharges

Only two point sources are recorded for this segment as listed in Exhibit B-18.2t, and both are in Guthrie. The Koppers Company employs 73 people in a creosote pressure treatment plant. Industrial waste is discharged into a lagoon and then to Spring Creek as shown in Exhibit 18.2t. Sanitary waste from the plant is treated by septic tank. Within the next year, Koppers plans to connect to a spray irrigation system for both industrial and domestic waste.

The Covington Mobile Home Park, located west of Guthrie near the intersection of Ky 294 and US 79, has a 6000 gpd extended aeration plant discharging into Spring Creek less than one mile from the state line.

Non-Point Source Discharges

Guthrie, with a population of approximately 1720, depends on septic tanks for domestic sewage disposal. A 201 Facility Plan is presently being prepared by Sverdrup & Parcel and Associates, Inc. in Nashville, Tennessee. This plan will investigate the feasibility of adding sewers and a treatment plant in the Guthrie area.

Waste Load Allocations and Priority

The segment 18 priority is only 1.7. This very low statewide ranking was calculated from the existing discharges in the basin and their characteristics. Since this is an effluent limited segment, no waste load allocations have been made as seen in Exhibit 18.3t.

The city of Guthrie is presently having a 201 Facilities Plan prepared. Since no plant exists in Guthrie, no discharge priority can be calculated. Projected needs for this area are shown in Exhibit B-18.4t.

Exhibit B-18.2t: Existing Discharge Characteristics (1975)

Code No.	Facility	Location	NPDES Permit No.	Treatment Type	Q7-10 (cfs)	Discharge Characteristics (mg/l)				
						Flow (mgd)	BOD	SS	NH_3	Other
02082	Koppers Industry	East Fork Spring Creek 58.9/125.3/ 1.3/6.0/11.0/4.1	N/A	Industrial	0.5	.03	-	-	-	Oil & Phenol
02090	Covington Mobile Home Park	East Fork Spring Creek 58.9/125.3/ 1.3/6.0/11.0/1.8	N/A	Extended Aeration	1.0	.006	15	20	2	-

Exhibit B-18.3t: Waste Load Allocations (1980)

Code No.	Facility	Max. Daily Waste Load lb/day	Proposed Effluent Characteristics/Load Reduction						Priority
			Flow (mgd)	BOD (mg/l)	SS (mg/l)	NH_3 (mg/l)	DO (mg/l)	Other	
02080	Koppers Industry	-	.03	-	-	-	-	N/A	-
02090	Covington Mobile	-	.006	30	30	20	4	-	-

Municipal Needs

A treatment plant, sufficient to serve the needs of Guthrie until 1995, would require approximately a 190,000 gpd operation. This size plant would have a predicted cost of $741,000. Collector needs of 66,000 feet would have a 1975 cost in excess of $1.4 million. Interceptor needs projected to 1995 would require $729,000. These needs are expected to be studied in greater detail in the 201 Facilities Plan presently being prepared.

Exhibit B-18.4t: Municipal Needs

Code Number	Facility	1980/1995 Treatment Needs	Cost Million	Compliance Goals
None	GUTHRIE	T4B/T4B		N/A
		T	0.741	
		I	0.729	
		C	1.400	

No other municipalities exist in this segment and no alternate plans have been studied.

SEGMENT #19 ANALYSIS

Classification: Water Quality Limited

Priority: 370.01

Location

As shown in Exhibit B-11.1m, Segment Basin #19 is located in Todd and Logan Counties. The segment consists of 106 square miles of land area, with 82 percent of the land located in Todd County and 24 percent in Logan County. The two largest population centers are Allensville (pop. 266) and Elkton (pop. 1,612).

Basic Planning Data

Segment #19 is projected to add 163 housing units, and 378 persons, between 1970 and 1995. Over 700 new employment opportunites are projected within the basin. Population density is expected to increase from 28 persons per square mile in 1970 to 31 persons per square mile in 1995. Urban-related land use is projected to increase by 0.07 square miles in order to accommodate increased rural non-farm population.

Exh. B-19.1t: Segment #19 Basic Planning Data*[1]

	1970	1975	1980	1995
Population Total	3,009	3,062	3,100	3,387
..Rural	3,009	3,062	3,100	3,387
..Farm	1,078	1,102	1,119	1,230
..Non-Farm	1,931	1,960	1,981	2,149
..Urban	0	0	0	0
Population Density ..Persons/sq.mi.	28.40	28.89	29.24	31.95
Housing Units	971	994	1,038	1,134
..Rural	971	994	1,038	1,134
..Urban	0	0	0	0
Non-Ag. Employment*[2]	-	-	(296)	(439)
..Manufacturing	-	-	(162)	(204)
..Non-Manufacturing	-	-	(134)	(235)
Land Use Total (sq.mi.)	106.00	106.00	106.00	106.00
..Rural	105.46	105.45	105.44	105.39
..Agriculture	105.46	105.45	105.44	105.39
..Silviculture	.00	.00	.00	.00
..Mining	.00	.00	.00	.00
..Construction	-	-	-	-
..Urban-Related	.54	.55	.56	.61

*[1]-for additional information on basic planning data, see Appendix "A".

*[2]-Employment figures in 1980 and 1995 columns are not at-year totals; but, rather are only the projected increase between 1975-80 and 1980-95.

Segment Hydrology

Segment 19, as shown by Exhibit B-11.1m, drains 106 square miles in southern Todd and southwestern Logan Counties. Elk Fork, the main stem of segment 19, has a Q7-10 of 0 at M.P. 26 and 2.66 at M.P. 7.4 at the Ky.-Tenn. state line. The southern half of this area is of karst topography, flat to rolling, with many sinkholes and natural ponds. The northern part of the segment is rolling to hilly with fewer sinkholes and a much better defined tributary system.

Water Quality Data

No monitoring stations with data exist in this segment and water quality has been predicted from the assumptions made in the 1975 and 1980 computer models. According to these estimates, water quality is poor from the Elkton STP at M.P. 29.1 to M.P. 22.5. This part of the stream exhibits a moderate slope, a high BOD loading, and a low D.O. concentration. The combination of these factors with the low-flow value of 0 at M.P. 28.8 results in the classification of this segment as Water Quality Limited.

Point Source Discharges

The only point source listed for this area as shown in Exhibit B-19.2t is Elkton STP with a plant capacity of 600,000 gpd. Average daily flow, based on population and an average discharge of 100 gal/cap-day, is 160,000 gpd. The plant is an activated sludge operation and is located one-half mile east of Ky 102 on Elk Fork Creek.

Non-Point Source Discharges

Elkton is the only community in Todd County and segment 19 operating a sewage collection and treatment system. The only other community of any size is Allensville. This small community of about 300 population has no formal water supply or sewage collection system and depends on septic tanks and other similar means for sewage disposal. Several other smaller communities in the segment also use septic fields for disposal and wells and springs for water supply. Although ground water quality has not been verified, the possibility of contamination due to septic field leaching could create a health hazard in the more densly populated areas. Agricultural runoff in this segment contributes silt, fertilizer, pesticides, and animal waste as non-point source pollution to surface waters and in the karst topography easily pollutes the ground water through sinkholes and solution channels. In general, non-point sources are not considered a great influence on the overall segment water quality.

Waste Load Allocations and Priority

Exhibit B-19.3t shows the proposed effluent

standards for Elkton STP in 1980. These values correspond to tertiary treatment with ammonia removal and, at an average daily flow of 159,000 gpd, would produce 27.4 lbs BOD/day. The segment priority calculated from segment population and waste overload is 370.01, a medium range statewide ranking.

The facility priority for Elkton STP is 917.62 calculated from the municipal needs presented in in Exhibit B-19.4t.

Exhibit B-19.4t: Municipal Needs

Code Number	Facility	1980/1995 Treatment Needs	Cost Million	Compliance Dates
02071	Elkton STP	T4B/T4B		7/1/77
		T	0.365	
		C	0.143	
		I	0.691	
		I/I	0.195	

Exhibit B-19.2t: Existing Discharge Characteristics (1975)

Code No.	Facility	Location	NPDES Permit No.	Treatment Type	Q7-10 (cfs)	Discharge Characteristics (mg/l) Flow (mgd)	BOD	SS	NH_3	Other
02071	Elkton STP	125.3/33.4/29.1	---	Activated Sludge	0	.1603	15	20	25	--

Exhibit B-19.3t: Waste Load Allocations (1980)

Code No.	Facility	Max. Daily Waste Load lb/day	Proposed Effluent Characteristics/Load Reduction Flow (mgd)	BOD (mg/l)	SS (mg/l)	NH_3 (mg/l)	DO (mg/l)	Other	Priority
02071	Elkton STP	27.36	.1594	10/95%	10/96%	1.0/95%	8.0	-	917.6

Municipal Needs

The present plant uses activated sludge treatment with primary and secondary settling. The waste sludge is anaerobically digested and spread on sludge drying beds. Projected treatment needs for 1980 call for T4B treatment with 168,000 gpd plant capacity, 82,000 gpd less than present plant capacity. Peak flows at the plant are around 400,000 gpd indicating a high infiltration-inflow take in the present sewer system.

To meet the 1980 proposed waste load allocation shown in Exhibit B-19.3t, the Elkton plant will need to add mixed media filtration and biological nitrification. These can be added for a 1975 cost of $365,000. New collectors needed for 1980 would require $143,000 for 6000 feet of installation. Interceptor needs for 1995 call for an estimated 21,000 feet at a cost of $691,000. To correct the present infiltration problem, an estimated $195,000 would be needed. The total municipal needs for the city of Elkton is $1.39 million.

Alternative Water Quality Management Plans

An alternative to T4B treatment would be to pump the present effluent approximately six miles to a point on the Elk Fork Creek where a minimum Q7-10 flow of 1 cfs exists. This would require a 300 gpm pump station, 32,000 feet of 8 inch force main, and operation and maintenance costs for a projected twenty years life span. The total cost of this alternate was $441,000 compared to $365,000 for treatment. The pumping scheme would not be entirely feasible since the Q7-10 flow values in this segment are not supported by any quantitative data from monitoring stations. The 201 Facility Plan for Elkton should analyze the feasible alternatives in great detail using stream sampling and available local information to evaluate the downstream effects of the treatment plant. It is quite possible that Q7-10 could be greater than 1 cfs at the treatment plant itself. Estimated Q7-10 low-flow values used for this analysis are only marginally adequate due to the lack of actual data in the LCRB.

SEGMENT #20 ANALYSIS

Classification: Effluent Limited Priority: 267.77

Location

As shown in Exhibit B-20.1m, Segment Basin #20 is located in Logan, Todd, and Simpson Counties. Segment #20 is the second largest basin in the Lower Cumberland River Basin, with 323.1 square miles of land area. Logan County holds the bulk (65 percent) of this land, while Todd has 12 percent, and Simpson has 23 percent. A small portion of Russellville (pop. 6,456) is located in the segment, while Adairville (pop. 973) is the next largest population center.

Basic Planning Data

Segment #20 is projected to add 1,339 housing units, and 3,532 persons between 1970 and 1995 (see Exh. B-20.2t). No new employment opportunities are projected within the segment basin. Population density is expected to increase from 29 persons per square mile in 1970 to 40 persons per square mile in 1995. Urban-related land use is projected to increase by 0.47 square miles by 1995, in order to accommodate needs of the urban and rural non-farm population growth.

Exh. B-20.2t: Segment #20 Basic Planning Data*[1]

	1970	1975	1980	1995
Population Total	9,460	10,153	10,638	12,992
..Rural	8,814	9,563	10,016	12,218
..Farm	4,285	4,682	4,914	6,026
..Non-Farm	4,529	4,881	5,102	6,192
..Urban	646	590	622	774
Population Density ..Persons/sq.mi.	29.28	31.42	32.92	40.21
Housing Units	3,053	3,344	3,596	4,392
..Rural	2,844	3,148	3,384	4,128
..Urban	209	196	212	264
Non-Ag. Employment	-	-	-	-
..Manufacturing	-	-	-	-
..Non-Manufacturing	-	-	-	-
Land Use Total (sq.mi.)	323.10	323.10	323.10	323.10
..Rural	321.64	321.54	321.48	321.17
..Agriculture	321.49	321.39	321.33	321.02
..Silviculture	.00	.00	.00	.00
..Mining	.15	.15	.15	.15
..Construction	-	-	-	-
..Urban-Related	1.46	1.56	1.62	1.93

*[1]-for additional information on basic planning data, see Appendix "A".

Segment Hydrology

As shown by Exhibit B-20.1m, Segment #20 drains approximately 323 square miles including portions of east-central Todd County, southern Logan County and southwest Simpson County. The drainage of this segment is carried primarily by the Red River and its tributaries from milepoint 50.2 at the Kentucky-Tennessee line flowing south to the Red River milepoint 80.6 where it recrosses the Kentucky-Tennessee line flowing north. The main tributaries in this segment serving the Red River are Dry Fork, Whippoorwill Creek, Dot River, South Fork Red River, Sulphur Spring Creek, and Pleasant Run.

Q7-10 stream flows range from 14.7 cfs in the Red River at milepoint 50.2 to zero cfs at milepoint 60.6. Q7-10 flows range from 1 to 3 cfs in portions of Whippoorwill Creek, Dot River, Pleasant Run, Sulphur Spring and the South Fork of Red River as shown by Exhibit 3.4m. The upper reaches of these main tributaries and other tributaries serving these main streams have zero Q7-10.

The topography in this segment varies from rolling to hills and is karsted with sinkholes catching and carrying underground much surface water runoff. Many of the smaller, intermittent streams run underground only to surface again as springs.

Water Quality Data

Some stream water quality data is available for this segment as shwon in Appendix A, Exhibit A-1.1t. Recorded data has been gathered on the South fork Red River below Adairville. This data shows no significant pollution, but oxygen levels which indicate the biochemical waste loading on the stream have not been measured. The computer model for determining in-stream water quality affected by Adairville sewage effluent shows a violation of the minimum dissolved oxygen level of 5.00 mg/l with in-stream oxygen levels in this zero Q7-10 flow stream dropping to zero mg/l concentration.

Future water quality data will be recorded in this segment by a state monitoring station located on Whippoorwill Creek near Dot, Kentucky.

Overall water quality in this segment is assumed to be very good with few point sources discharging as shown by Exhibit B-20.3t. This segment is classified as Effluent Limited since its main drainage stem, Red River, does not have stream water quality violations when point discharges in the segment meet secondary treatment requirements. This was determined by the computer stream model assuming secondary treatment and modeling the streams for 1980 projected waste loads from secondary treatment at existing point discharges.

Point Source Discharges

The only two recorded point sources of pollution in this segment are listed with their discharge characteristics in Exhibit B-20.3t; they are Adairville and Olmstead School.

Adairville, a community of approximately 1000 population is served by a contact stabilization convertible to extended aeration package (factory built) sewage treatment plant having an estimated hydraulic

LOWER CUMBERLAND RIVER BASIN

EXHIBIT B-20.1m 20 Thru 22

SEGMENT MAP

LEGEND

DISCHARGERS

- M 00 — **MAJOR (OVER 1.0 MGD)**
- M 00 — **PRINCIPAL (LESS THAN 1.0 MGD)**
- **(M) MUNICIPAL DISCHARGERS**
- **(D) DOMESTIC DISCHARGERS**
- SW — **SOLID WASTE**

5 4 3 2 1 0 5

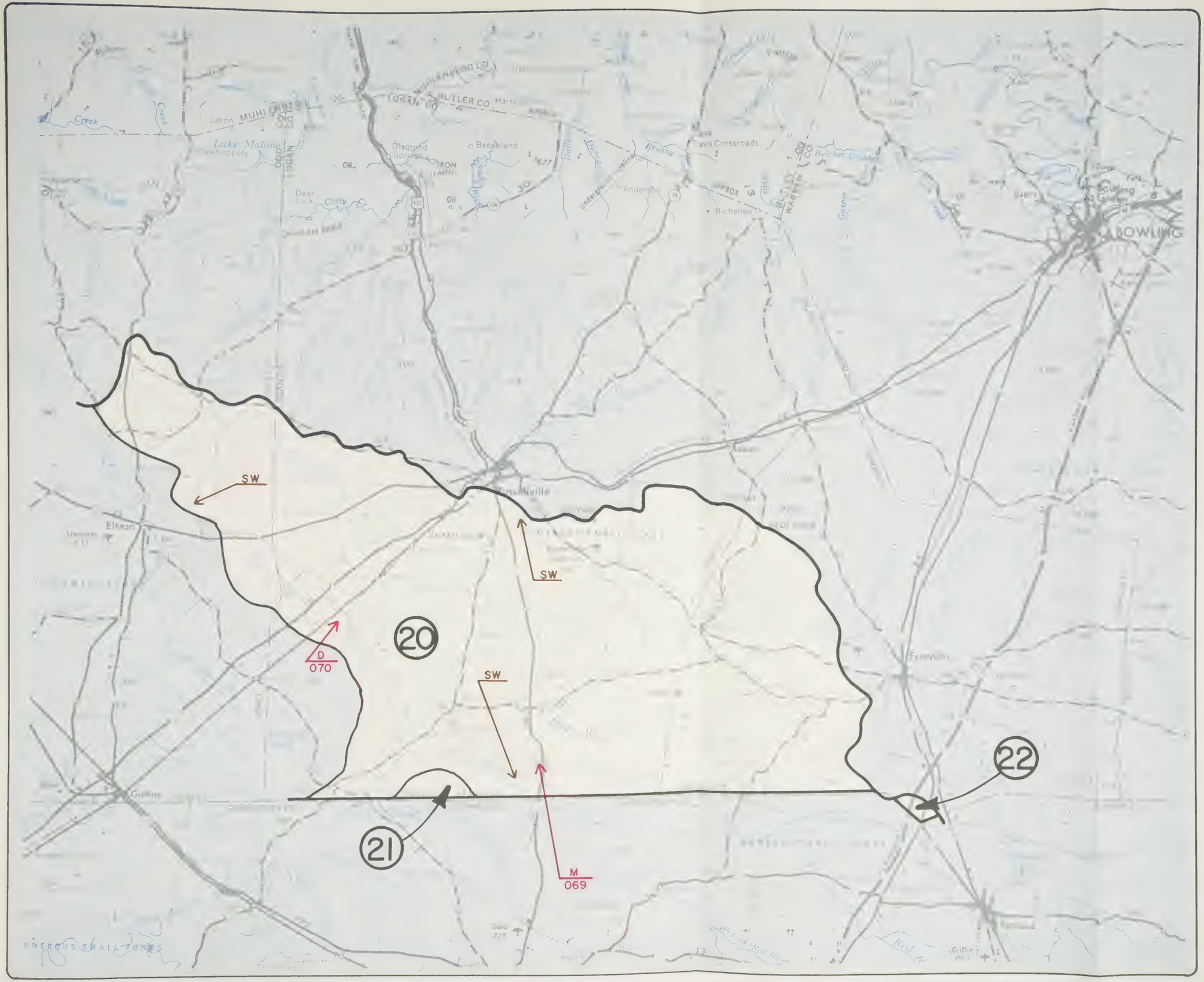
GRAPHIC SCALE IN MILES

Base Data: U. S. Geological Survey

KENTUCKY WATER QUALITY MANAGEMENT PLAN

Prepared for Division of Water Quality
KENTUCKY DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION

C. REYNOLDS WATKINS CONSULTING ENGINEERS, INC.
Lexington, Bowling Green & Louisville, Kentucky



LOWER CUMBERLAND RIVER BASIN

EXHIBIT B-20.1m 20 Thru 22

SEGMENT MAP

LEGEND

DISCHARGERS

- M 00 — **MAJOR (OVER 1.0 MGD)**
- M 00 — **PRINCIPAL (LESS THAN 1.0 MGD)**
- **(M) MUNICIPAL DISCHARGERS**
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GRAPHIC SCALE IN MILES

Base Data: U. S. Geological Survey

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capacity of 150,000 gallons per day. This plant, when operating properly at or below capacity, has the capability of achieving secondary level waste treatment (30 mg/l BOD_5 and SS and NH_3 as low as 2 mg/l). The current removal rates are not believed to be at design efficiency as shown by Exhibit 20.3t. This facility, built in 1964, serves almost the entire community of Adairville with a fairly complete collection system. There has been overloading of this plant organically in the past due to untreated effluent from Odom Sausage Company meat packing plant. The organic loading from Odom Sausage Company has been approximately twice that from all of Adairville as described in the 1972 Barren River Area Development District Water and Sewer Plan.

Olmstead School discharges approximately 5500 gallons per day of effluent from a settling tank with sand filter treatment facility. This discharge is located on Vicks Branch, a tributary to Whippoorwill Creek.

Non-Point Source Discharges

No significant non-point discharges are located in this segment. Some non-point pollution occurs during times of heavy rainfall with agricultural silt, fertilizer, pesticide and animal waste runoff. This non-point pollution is weakened with the pollution problems caused by agricultural runoff.

Minor sources of non-point pollution occur from scattered septic tanks, cesspools, and pit latrines serving the rural community, but affect only local areas of ground water. No major ground water problems due to these sources are recorded for this segment.

Waste Load Allocations and Priority

Waste load allocations for the point sources in this segment are listed in Exhibit B-20.4t along with the computed facility priority for the municipal discharge and the proposed effluent characteristics for these sources which would keep them from violating stream water quality standards. These waste load allocations are based on 1980 estimated flows and required levels of treatment to meet water quality standards. The waste loads allocated are low at these discharges since each discharge into zero Q7-10 flow streams requires a minimum T4B treatment level (10 mg/l BOD_5, and SS with NH_3 = 1 mg/l and D.O. = 8 mg/l) as shown by the computer modeling for these streams.

Compliance goals for the municipal discharges at Adairville to meet proposed effluent characteristics are assumed to be July 1, 1977 from P.L. 92-500 if monies are made available from state and federal levels. The domestic discharge, Olmstead School will require consideration, though the law states July 1, 1977 as the schedule for compliance with water quality standards. A serious question must be resolved before compliance goals are firmly set and that is the question of what is a significant source of pollution even on Zero Q7-10 flow streams?

The segment priority of 267.77 is due primarily to the stringent treatment requirements for Adairville.

Municipal Needs

Determination of the municipal needs for Adairville, the only sewered municipality in this segment, have been made from the 1980 and 1995 computer simulation runs. These needs are outlined in Exhibit B-20.5t as follows:

Exhibit B-20.5t - Municipal Needs

Code Number	Facility	1980/1995 Treatment Needs	Costs Millions	Compliance Goals
02069	Adairville STP Priority 19.6	T4B/T4B	T-.083 I-.082 C-.062 I/I-.063	7/1/77

As shown in Exhibit B-20.5t, tertiary treatment is required to satisfy stream water quality standards for 1980 and 1995.

The existing extended aeration plant provides only secondary treatment. An evaluation of needed modification to the existing plant to meet a tertiary

Exhibit B-20.4t: Waste Load Allocations (1980)

Code No.	Facility	Max. Daily Waste Load lb/day	Proposed Effluent Characteristics/Load Reduction						Priority
			Flow (mgd)	BOD (mg/l)	SS (mg/l)	NH_3 (mg/l)	DO (mg/l)	Other	
02069	Adairville STP	25.02	.1085	10/95%	10/96%	1.0/96%	8.0	-	19.6
02070	Olmstead School	0.92	.0055	10/95%	10/96%	1.0/96%	8.0	-	-

Exhibit B-20. 3t: Existing Discharge Characteristics (1975)

Code No.	Facility	Location	NPDES Permit No.	Treatment Type	Q7-10 (cfs)	Discharge Characteristics (mg/l)				
						Flow (mgd)	BOD	SS	NH_3	Other
02069	Adairville STP	S. Fork Red Riv. 125.3/56.3/5.3	KY0020885	Contact Stabilization	0	.1029	40	100	20	--
02070	Olmstead School	Vicks Branch 54.2/11.9/.9	---	Settling Tank w/ Sand Filter	0.81	.0055	40	100	1	--

treatment level yielded an estimated cost of $33,000. This treatment cost estimate and estimated costs to provide collectors, interceptors and infiltration/ inflow evaluation and correction for this community are all listed in Exhibit B-20.5t. The collector sewers are those needed by 1980, whereas the treatment and interceptor facilities are sized for 1995 needs. Estimating cost curves utilized are those recommended by EPA.

The treatment plant modifications required to meet 1980 needs are addition of mixed media filtration followed by aeration ladder to the existing extended aeration plant.

Alternative Water Quality Management Plans

Alternative methods of handling the Adairville wastewater effluent have been investigated, including various tertiary treatment methods, pumping secondary effluent downstream to a point where mimimum Q7-10 flows provide dilution suitable for accepting secondary waste treatment, pumping to another treatment facility and secondary waste land application.

The alternate methods of tertiary treatment, such as polishing ponds with micro-strainers, and carbon column filtration, were found to be much more expensive than mixed media filtration.

Land application of secondary effluent as an alternate to tertiary treatment was ruled out due to poor soil suitability in this entire area and high susceptibility to ground water contamination in this karst topography. Pumping to another treatment facility is not feasible since there are no major facilities nearby. Pumping downstream to a point of higher Q7-10, low flow is feasible but three times as costly to install pump station, force main, and operate and maintain as to provide tertiary treatment.

Water quality standards as applied to this segment appear to create undue hardship on the community of Adairville by demanding tertiary treatment without adequate stream flow data to justify these requirements. A gauging station should be placed upstream of Adairville on South Fork Red River and monitored for a sufficient period to determine actual Q7-10 low flow in this stream prior to demanding tertiary treatment.

The Adairville area has been designated planning area, however, the detailed information required for proper cost effective alternatives for waste treatment and/or disposal is not available. Should a 201 plan be done for this area, it would more clearly define the needs and methods for correcting them.

SEGMENT #21 ANALYSIS

Classification: Effluent Limited Priority: -0-

Location

As shown in Exhibit B-20.1m, Segment Basin #21 is located in Logan County. The segment is extremely small, with only 3 square miles of land area. There is no population concentration within the segment.

Basic Planning Data

Segment #21 is projected to add 14 housing units, and 35 persons between 1970 and 1995 (see Exh. B-21.1t). There is no projected employment growth within the segment. Population density is expected to increase from 28 persons per square mile in 1970 to 39 persons per square mile in 1995.

Exh. B-21.1t: Segment #21 Basic Planning Data*[1]

	1970	1975	1980	1995
Population Total	84	91	96	119
..Rural	84	91	96	119
..Farm	39	42	44	55
..Non-Farm	45	49	52	64
..Urban	0	0	0	0
Population Density ..Persons/sq.mi.	28.00	30.30	32.00	39.60
Housing Units	27	30	33	41
..Rural	27	30	33	41
..Urban	0	0	0	0
Non-Ag. Employment	-	-	-	-
..Manufacturing	-	-	-	-
..Non-Manufacturing	-	-	-	-
Land Use Total (sq.mi.)	3.00	3.00	3.00	3.00
..Rural	2.99	2.99	2.99	2.99
..Agriculture	2.99	2.99	2.99	2.99
..Silviculture	.00	.00	.00	.00
..Mining	.00	.00	.00	.00
..Construction	-	-	-	-
..Urban-Related	.01	.01	.01	.01

*[1]-for additional information on basic planning data, see Appendix "A".

Segment Hydrology

Segment #21, as shown by Exhibit B-20.1m, drains approximately 3 square miles of the southern portion of Logan County into Tennessee. This area of karst topography, mottled with sinkholes and ponds, sheds its water toward Spring Creek in Tennessee. No major streams or tributaries exist in this segment and it is singled out only because of the state boundary which separates it from its major watershed in Tennessee.

Water Quality Data

Water quality data is nonexistent for this small segment and there are no tributaries located therein to be affected by stream water quality standards. The groundwater in this segment is assumed fine with no concentrations of population to adversly affect it.

Point Source Discharges

Point source discharges are also nonexistent in this segment with no municipalities or industries to contribute.

Non-Point Source Discharges

No significant non-point sources of pollution exist in this segment with the sparse and spread-out homes adding little to the groundwater from their septic tanks, cesspools and pit-toilets. Slight agricultural pollution of silt, fertilizer, pesticides and animal waste would add a little surface non-point pollution to Tennessee.

Waste Load Allocations and Segment Priority

Waste load allocations are not made for this segment with no point sources or tributaries for waste load allocations. The segment priority based on population is insignificant and meaningless and is assigned a value of zero.

SEGMENT #22 ANALYSIS

Classification: Effluent Limited Priority: -0-

Location

As shown in Exhibit B-20.1m, Segment Basin #22 is located in Simpson County, and is the smallest segment basin in the Lower Cumberland River Basin, at 0.8 square miles of land area. The segment is bisected by Inter-state 65 at the Kentucky-Tennessee border.

Basic Planning Data

Segment #22 is expected to increase by four housing units, and by eleven people between 1970 and 1995 (see Exh. B-22.1t). There is no projected employment growth within the segment. Population density is expected to increase from 27 persons per square mile in 1970 to 41 persons per square mile in 1995.

Exh. B-22.1t: Segment #22 Basic Planning Data*[1]

	1970	1975	1980	1995
Population Total	22	25	27	33
..Rural	22	25	27	33
..Farm	14	16	18	21
..Non-Farm	8	9	9	12
..Urban	0	0	0	0
Population Density ..Persons/sq.mi.	27.50	31.25	33.75	41.25
Housing Units	7	8	9	11
..Rural	7	8	9	11
..Urban	0	0	0	0
Non-Ag. Employment	-	-	-	-
..Manufacturing	-	-	-	-
..Non-Manufacturing	-	-	-	-
Land Use Total (sq.mi.)	.80	.80	.80	.80
..Rural	.80	.80	.80	.80
..Agriculture	.80	.80	.80	.80
..Silviculture	.00	.00	.00	.00
..Mining	.00	.00	.00	.00
..Construction	-	-	-	-
..Urban-Related	0	0	0	0

*[1]-for additional information on basic planning data, see Appendix "A".

Segment Hydrology

Segment #22, as shown by Exhibit B-20.1m, drains 0.8 square miles of the southern most tip of Simpson County south into Tennessee. The surface water from this karst topography runs south into Summers Branch in Tennessee, which is tributary to the Red River, eventually flowing back into Kentucky.

Water Quality Data

Water quality data is nonexistent for this small segment and there are no tributaries located therein to be affected by stream water quality standards. The groundwater in this segment is assumed fine with no concentrations of population to adversly affect it.

Point Source Discharges

Point source discharges are also nonexistent in this segment with no municipalities or industries to contribute.

Non-Point Source Discharges

No significant non-point sources of pollution exist in this segment with the sparse and spread-out homes adding little to the ground water from their septic tanks, cesspools and pit-toilets. Slight agricultural pollution of silt, fertilizer, pesticides and animal waste would add a little surface non-point pollution to Tennessee.

Waste Load Allocations and Segment Priority

Waste load allocations are not made for this segment with no point sources or tributaries for waste load allocations. The segment priority based on population is insignificant and meaningless and is assigned a value of zero.

Appendix "D"

DEFINITION OF TERMS

ACT, THE - Public Law 92-500. "This Act may be cited as the 'Federal Water Pollution Control Act Amendments of 1972.'" (Act, sec. 1).

ACTIVATED SLUDGE - A flocculent assemblage of microorganisms, nonliving organic matter, and inorganic materials.

AERATED POND - A natural or artificial wastewater treatment pond in which mechanical or diffused-air aeration is used to supplement the oxygen supply.

ANAEROBIC WASTE TREATMENT - Waste stabilization brought about through the action of microorganisms in the absence of air or elemental oxygen. Usually refers to waste treatment by methane fermentation.

AQUIFER - A permeable material through which groundwater moves.

ASSIMILATION - The absorption and utilization of a nutrient by an organism.

ASSIMILATIVE CAPACITY - The capacity of a natural body of water to receive: (a) wastewaters, without deleterious effects; (b) toxic materials, without damage to aquatic life or humans who consume the water, (c) BOD, within prescribed dissolved oxygen limits.

BASIN - "The term 'basin' means the streams, rivers, and tributaries and the total land and surface water area contained in one of the major and minor basins defined by EPA, or other basin unit as agreed upon by the state(s) and the Regional Administrator." (proposed regulations 40 CFR 130.2(l)).

BASIN PLAN - The water quality management plan for each hydrologic basin or other approved basin unit within a state. Such plans form a basis for implementing applicable effluent limitations and water quality standards, and consist of such elements as are necessary for sound planning and program management in the basin covered by the plan.

BEST AVAILABLE TECHNOLOGY (BAT) - "Not later than July 1, 1983, effluent limitations for categories and classes of point sources, other than publicly owned treatment works,...shall require application of the best available technology economically achievable for such category or class, which will result in reasonable further progress toward the national goal of eliminating the discharge of all pollutants as determined in accordance with regulations issued by the Administrator pursuant to section 304(b)(2) of this Act." (Act, sec. 201(b)(2)(A)).

BEST PRACTICABLE CONTROL TECHNOLOGY (BPCT) - "Not later than July 1, 1977, effluent limitations for point sources, other than publicly owned treatment works, shall require the application of the best practicable control technology currently available as defined by the Administrator pursuant to section 304(b) of the Act." (Act, sec. 301(b)(1)(A)). This is also referred to as Best Practicable Technology (BPT).

BEST PRACTICABLE WASTE TREATMENT TECHNOLOGY (BPWTT) - "Waste treatment management plans and practices shall provide for the application of the best practicable waste treatment technology before any discharge into receiving waters, including reclaiming and recycling of water and confined disposal of pollutants so they will not migrate to cause water or other environmental pollution." (Act, sec. 201(b)).

BIOCHEMICAL OXYGEN DEMAND (BOD) - (1) The quanity of oxygen used in the biochemical oxidation of organic matter in a specified time, at a specified temperature, and under specified conditions. (2) A standard test used in assessing wastewater strength.

BIOLOGICAL WASTEWATER TREATMENT - Forms of wastewater treatment in which bacterial or biochemical action is intensified to stabilize, oxidize, and nitrify the unstable organic matter present. Intermittent sand filters, contact beds, trickling filters, and activated sludge processes are examples.

CHEMICAL OXYGEN DEMAND (COD) - A measure of the oxygen consuming capacity of inorganic and organic matter present in water or wastewater. It is expressed as the amount of oxygen consumed from a chemical oxidant in a specific test. It does not differentiate between stable and unstable organic matter and thus does not necessarily correlate with biochemical oxygen demand.

CLAY - A fine-textured soil that breaks into very hard clods or lumps when dry, and is plastic and unusually sticky when wet. When a ball of moist soil is pressed between the thumb and finger, it will form a long ribbon.

CLAY LOAM - A fine-textured soil which breaks into clods or lumps that are hard when dry. When a ball of moist soil is pressed between the thumb and finger it will form a thin ribbon that will break readily, barely sustaining its own weight. The moist soil is plastic and will form a cast that will withstand considerable handling.

COMBINED SEWER - "A sewer intended to serve as a sanitary sewer and a storm sewer, or as an industrial sewer and a storm sewer." (40 CFR 35.905-2)

DATA - Records of observations and measurements of physical facts, occurrences, and conditions, reduced to written, graphical, or tabular form.

DENITRIFICATION - A biological process in which gaseous nitrogen is produced from nitrite and nitrate.

DISCHARGE OF POLLUTANTS - "The term 'discharge of a pollutant' and the term 'discharge of pollutants' each means (a) any addition of any pollutant to navigable waters from any point source, (b) any addition of any pollutant to the waters of the contiguous zone or the ocean from any point source other than a vessel or other floating craft." (Act, sec. 502(12)).

DISSOLVED SOLIDS - Theoretically, the anhydrous residues of the dissolved constituents in water. Actually, the term is defined by the method used in determination.

In water and wastewater treatment the Standard Methods tests are used.

EFFLUENT LIMITATION - "The term 'effluent limitation' means any restriction established by a state or the Administrator on quantities, rates, and concentrations of chemical, physical, biological, and other constituents which are discharged from point sources into navigable waters, the waters of the contiguous zone, or the ocean, including schedules of compliance." (Act, sec. 502(11)).

EFFLUENT LIMITED SEGMENTS - "Any segment where water quality is meeting and will continue to meet applicable water quality standards or where there is adequate demonstration that water quality will meet applicable water quality standards after the application of the effluent limitations required by sections 301(b)(1)(A) and 301(b)(1)(B) of the Act." (proposed regulations, 40 CFR part 131).

EROSION - Movement of material from one place to another on the earth's surface. Agents of movement include water, ice, wind, and gravity.

FACILITIES PLANNING - Pertains to "provision for cost-effective, environmentally sound and implementable treatment works which will meet applicable requirements of sections 201(g), 301, and 302 of the Act." (201 guidance, p.3).

FATS (WASTES) - Triglyceride esters of fatty acids. Erroneously used as synonomous with grease.

GAUGING STATION - A location on a stream or conduit where measurements of discharge are customarily made. The location includes a stretch of channel through which the flow is uniform and a control downstream from this stretch. The station usually has recording or other gauge for measuring the elevation of the water surface in the channel or conduit.

GREASE - In wastewater, a group of substances including fats, waxes, free fatty acids, calcium and magnesium soaps, mineral oils, and certain other nonfatty materials. The type of solvent and method used for extraction should be stated for quantification.

HARDNESS - A characteristic of water, imparted by salts of calcium, magnesium, and iron such as bicarbonates, carbonates, sulfates, chlorides, and nitrates, that cause curdling of soap, deposition of scale in boilers, damage in some industrial processes, and sometimes objectionable taste. It may be determined by a standard laboratory procedure or computed from the amounts of calcium and magnesium as well as iron, aluminum, manganese, barium, strontium, and zinc, and is expressed as equivalent calcium carbonate.

INDUSTRIAL WASTES - The liquid wastes from industrial processes, as distinct from domestic or sanitary wastes.

INFILTRATION - "The water entering a sewer system, including sewer service connections, from the ground, through such means as, but not limited to, defective pipes, pipe joints, connections, and manhole walls. Infiltration does not include, and is distinguished from, inflow." (40 CFR 35.905-9).

INFLOW - "The water discharged into a sewer system, including service connections, from such sources as, but not limited to, roof leaders, cellar, yard and area drains, foundation drains, cooling water dischargers, drains from spring and swampy areas, manhole covers, cross connections from storm sewers and combined sewers, catch basins, storm waters, surface runoff, street wash waters, or drainage. Inflow does not include, and is distinguished from, infiltration." (40 CFR 35.905-11).

LAGOON - (1) A shallow body of water, as a pond or lake, which usually has a shallow, restricted inlet from the sea. (2) A pond containing raw or partially treated wastewater in which aerobic or anaerobic stabilization occurs.

LAND USE - The physical mode of utilization or conservation of a given land area at a given point in time.

LAND USE CONTROLS - Methods for regulating the uses to which a given land area may be put, including such things as zoning, subdivision regulation, and floodplain regulation.

LOAM - Consists of an even mixture of the different sizes of sand and of silt and clay. It is easily crumbled when dry and has a slightly gritty, yet fairly smooth feel. It is slightly plastic. Squeezed in the hand when dry, it will form a cast that will withstand careful handling. The cast formed of moist soil can be handled freely without breaking.

LOESS - An unconsolidated, unstratified aggregation of small, angular mineral fragments, usually buff in color. Generally believed to be wind deposited. Characteristically able to stand on very steep to vertical slopes.

MAXIMUM DAILY LOAD - "Each plan shall include for each water quality segment identified pursuant to sec. 131.203, the total maximum daily loads of pollutants, including thermal loads, allowable for each specific criterion being violated or expected to be violated." (proposed regulations 40 CFR part 131.205)

MOST PROBABLE NUMBER (MPN) - That number of organisms per unit volume that, in accordance with statistical theory, would be more likely than any other number to yield the observed test result with the greatest frequency. Expressed as density of organisms per 100 ml. Results are computed from the number of positive findings of coliform-group organisms resulting from multiple-portion decimal-dilution plantings.

MUNICIPAL NEEDS - The total capital funding required for construction of publicly owned treatment works, as defined in section 212(2)(A) and (B) of the Act, required to meet national water quality objectives of sections 301 and 302 of the Act.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) - The national permitting system authorized under section 402 of the Act, including any state or interstate permit program which has been approved by the Administrator pursuant to section 402 of the Act.

NAVIGABLE WATERS - "The term 'navigable waters' means the waters of the United States, including the territorial seas." (Act, sec. 502(7)).

NITRIFICATION - The conversion of nitrogenous matter into nitrates by bacteria.

NONPOINT SOURCE - Generalized discharge of waste into a water body which cannot be located as to specific source, as outlined in section 304(e) of the Act.

NUTRIENT - Any substance assimilated by organisms which promotes growth and replacement of cellular constituents.

ORGANIC MATTER - Chemical substances of animal or vegetable origin, or more correctly, of basically carbon structure, comprising compounds consisting of hydrocarbons and their derivatives.

ORGANIC NITROGEN - Nitrogen combined in organic molecules such as protein, amines, and amino acids.

OXIDATION - The addition of oxygen to a compound. More generally, any reaction which involves the loss of electrons from an atom.

OXIDATION POND - A basin used for retention of wastewater before final disposal, in which biological oxidation of organic material is effected by natural or artifically accelerated transfer of oxygen to the water from air.

PATHOGENIC BACTERIA - Bacteria which may cause disease in the host organisms by their parasitic growth.

PERCHED WATER TABLE - The top of a zone of saturation that bottoms on an impermeable horizon above the level of the general water table in the area. Is generally near the surface and frequently supplies a hillside spring.

PERMEABILITY - For a rock or an earth material, the ability to transmit fluids. Permeability for underground water is sometimes expressed numerically as the number of gallons per day that will flow through a cross section of one square foot at 60°F, under a hydraulic gradient of 100 percent. Permeability is equal to velocity of flow divided by hydraulic gradient.

pH - The reciprocal of the logarithm of the hydrogen ion concentration. The concentration is the weight of hydrogen ions, in grams per liter of solution. Neutral water, for example, has a pH value of 7 and hydrogen ion concentration of 10^{-7}

PHASING OF PLANNING - The state schedule approved by the Regional Administrator for preparation of basin plans.

PLANNING AGENCY - "The governor...or governors shall ...designate each 208 planning area including its boundaries, and for each area a single representative agency to be responsible for the planning....The agency shall be a representative organization whose membership shall include, but need not be limited to, elected officials of local governments, or their designees, having jurisdiction in the designated planning area." (40 CFR 126.12, 126.13, 126.11).

PLANNING PERIOD - "The period over which a waste treatment management system is evaluated for cost-effectiveness. The planning period commences with the initial operation of the system." (40 CFR Appendix A, d(3)). In this case, the planning period is 20 years.

PLANNING PROCESS - Strategy for directing resources, establishing priorities, scheduling actions, and reporting programs toward achievement of program objectives.

POINT SOURCE - "The term 'point source' means any discernible, confined and discrete conveyance, including, but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or can be discharged." (Act, sec. 502 (14)).

POLLUTANT - "The term 'pollutant' means dredged spoil, soil, solid waste, incinerator residue, sewage, sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water." (Act, sec. 502(6)).

PRETREATMENT - "The Administrator shall...publish proposed regulations establishing pretreatment standards for introduction of pollutants into treatment works...which are publicly owned for those pollutants that are determined not to be susceptible to treatment by such treatment works or which would interfere with the operation of such treatment works." (Act, sec. 307(b)(1). "Not later than July 1, 1977,...in the case of discharge into a publicly owned treatment works,...shall require compliance with any applicable pretreatment requirements...under section 307 of this Act." (Act, sec. 301(b)(1)(A).

PRIMARY SETTLING TANK - The first settling tank for the removal of settleable solids through wihch wastewater is passed in a treatment works.

PRIMARY TREATMENT - (1) The first major (sometimes the only) treatment in a wastewater treatment works, usually sedimentation. (2) The removal of a substantial amount of suspended matter but little or no colloidal and dissolved matter.

SANDY LOAM - Consists largely of sand, but has enough silt and clay present to give it a small amount of stability. Individual sand grains can be seen and felt readily. Squeezed in the hand when dry, this soil will fall apart when the pressure is released. Squeezed when moist, it forms a cast that will not only hold its shape when the pressure is released but will withstand careful handling without breaking. The stability of the moist cast differentiates this soil from sand.

SANITARY SEWER - A sewer that carries liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions, together with minor quantities of groundstorm, and surface waters that are not admitted intentionally.

SCHEDULE OF COMPLIANCE - Remedial measures to be accomplished and a sequence of actions or operations leading to compliance with applicable effluent limitations, water quality standards and other requirements of state and federal law. Schedule of complience includes those sequenced actions or operations contained in a National Pollutant Discharge Elimination System permit which are legally binding on the discharger; whereas, the term "target abatement dates" means a sequence of actions or control measures which have not been formally adopted through the permit process and therefore are not legally binding on the discharger until they are adopted in a permit.

SECONDARY SETTLING TANK - A tank through which effluent from some prior treatment process flows for the purpose of removing settleable solids.

SECONDARY TREATMENT - "There shall be required...for

publicly owned treatment works in existence on July 1, 1977, or approved...prior to June 30, 1974...effluent limitations based upon secondary treatment as defined by the Administrator pursuant to section 304(d)(1) of this Act." (Act, sec. 301(b)(1)(B)). "The Administrator...shall publish...information, in terms of amounts of constituents and chemical, physical, and biological characteristics of pollutants, on the degree of effluent reduction attainable through the application of secondary treatment." (Act, sec. 304(d)(1)).

SEDIMENTATION - The process of subsidence and deposition of suspended matter carried by water, wastewater, or other liquids, by gravity. It is usually accomplished by reducing the velocity of the liquid below the point at which it can transport the suspended material. Also called settling.

SEGMENT - A portion of a basin, the surface waters of which have common hydrologic characteristics (or flow regulation patterns); common natural physical, chemical, and biological processes; and common reactions to external stresses, such as the discharge of pollutants.

SELF-PURIFICATION - The natural processes occurring in a stream or other body of water that result in the reduction of bacteria, satisfaction of the BOD, stabilization of organic constituents, replacement of depleted dissolved oxygen, and the return of the stream biota to normal. Also called natural purification.

SIGNIFICANT DISCHARGE - Any point source discharge for which timely management action must be taken in order to meet the water quality objectives for the basin within the period of the operative basin plan. The significant nature of the discharge is to be determined by the state, but must include, at a minimum, any discharge which is causing or will cause serious or critical water quality problems relative to the segment to which it discharges.

SILT LOAM - Consists of a moderate amount of fine grades of sand, a small amount of clay, and a large quantity of silt particles. Lumps in a dry, undisturbed state appear quite cloddy but they can be pulverized readily; the soil then feels soft and floury. When wet, silt loam runs together and puddles. Either dry or moist casts can be handled freely without breaking. When a ball of moist soil is pressed between thumb and finger, it will not press out into a smooth, unbroken ribbon, but will have a broken appearance.

SLUDGE DIGESTION - The process by which organic or volatile matter in sludge is gasified, liquified, mineralized, or converted into more stable organic matter through the activities of either anaerobic or aerobic organisms.

SLUDGE THICKENING - The increase in solids concentration of sludge in a sedimentation or digestion tank.

STABILIZATION LAGOON - A shallow pond for storage of wastewater before discharge. Such lagoons may serve only to detain and equalize wastewater composition before regulated discharge to a stream, but often they are used for biological oxidation.

STABILIZATION POND - A type of oxidation pond in which biological oxidation of organic matter is effected by natural or artificially accelerated transfer of oxygen to the water from air.

STATE WATER QUALITY STANDARDS - Standards of water quality set by the state for intrastate waters, that shall be at least as stringent as federal standards and shall further the goals of the Act.

STORM SEWER - A sewer intended to carry only storm waters, surface runoff, street wash waters, and drainage. (40 CFR 35.905-22).

SUSPENDED SOLIDS - (1) Solids that either float on the surface of, or are in suspension in water, wastewater, or other liquids, and which are largely removable by laboratory filtering. (2) The quantity of material removed from wastewater in a laboratory test, as prescribed in "Standard Methods for the Examination of Water and Wastewater" and referred to as nonfilterable residue.

THEORETICAL OXYGEN DEMAND - The theoretical quantity of oxygen required for the oxidation of an organic material.

TOPOGRAPHY - The shape and physical features of the land.

TOTAL OXYGEN DEMAND - (1) Commonly, the total quantity of oxygen required to satisfy completely the first-stage biochemical oxygen demand. (2) More strictly, the quantity of oxygen required to satisfy completely both the first-stage and the second-stage biochemical oxygen demands.

UPSTREAM POLLUTANT SOURCE - Source of pollutants discharged into the receiving waters which is located upstream from the area of consideration.

WASTE LOAD ALLOCATION - "A waste load allocation for a segment is the assignment of target loads to point and non-point sources so as to achieve water quality standards in the most effective manner." (303 guidelines).

WASTE TREATMENT FACILITIES - "Any devices and systems used in the storage, treatment, recycling and reclamation of municipal sewage or industrial wastes of a liquid nature...in addition,...any other method or system for preventing, abating, reducing, storing, treating, separating, or disposing of municipal waste, including waste in combined storm water and sanitary sewer systems." (Act, sec. 212(2)). Also termed treatment works.

WATER QUALITY LIMITED SEGMENTS - "Any segment where it is known that water quality does not meet applicable water quality standards, and is not expected to meet water quality standards even after the application of the effluent limitations required by sections 301(b)(1)(A) and 301(b)(1)(B) of the Act." (proposed regulations 40 CFR part 131).

1983 GOALS - Pertains to goals outlined in sec. 101(a) and elsewhere in the Act.

1977 GOALS - Pertains to the July 1, 1977 milestone set by the Act, particularly in terms of treatment technology and limitations.

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Appendix "F": STATUS OF

PLANNING AND LAND USE CONTROLS

INTRODUCTION

The staff of the Pennyrile Area Development District has compiled a listing of the community plans and land use controls (or plan implementation aids) in existence for the entire Area Development District, and for each city and county within the District. The listing for the ADD, and the cities and counties within the Lower Cumberland River Basin is described in the remainder of this Appendix. The year of preparation and/or adoption also is included for each item.

PENNYRILE AREA DEVELOPMENT DISTRICT

..Initial Overall Economic Development Program...1970
..Second Stage Overall Economic Development Program.....1971
..Solid Waste Plan.....1971
..Pennyrile Regional Corrections System.....1972
..Economic Evaluation of the Pennyrile Area Development with Emphasis on Industrial Sites.....1972
..Health Maintenance Organizations and Health Care Planning in the Pennyrile Area Development District.....1972
..Pennyrile Emergency Medical Services Plan.....1973
..Personal and Intermediate Care Facility Plan...1973
..Initial Housing Element.....1973
..Comprehensive Sewer and Water Plan.....1973
..Regional Environment Land Use Plan.....1973
..Goals and Objectives.....1974
..Overall Program Design.....1974
..Housing Administration Program.....1974
..Pennyrile Area Manpower Council CAMPS Plan FY '75.....1974

CALDWELL COUNTY

..Soil Survey.....1966
..Donaldson Creek Watershed - Feasibility Analysis.....1970
..Housing Element Information Study.....1973

Princeton

..Base Map.....1958
..Zoning Ordinances and Map.....1958
..Subdivision Regulations.....1958
..Land Use Analysis.....1962
..Existing Land Use Map.....1962
..Base Map (Maj. Rev.).....1963
..Existing Land Use Map (Maj. Rev.).....1963
..Existing Land Use Analysis.....1963
..Population Study.....1964
..Economic Base.....1964
..Major Thoroughfare Plan.....1967
..Land Use Plan.....1967
..Community Facilities Plan.....1967
..Zoning Ordinance (Rev.).....1967
..Subdivision Regulations.....1970
..Housing Element.....1970
..Princeton Fringe Area Study and Housing Plan...1973
..Princeton Townlift Plan.....1973
..Master Plan Study: Princeton-Caldwell County Airport.....1973

CHRISTIAN COUNTY

..North Fork of Little River Watershed.....1960
..East Fork of Pond River Watershed.....1961
..West Fork of Pond River Watershed.....1962
..South Fork of Little River Watershed.....1963
..Upper Tradewater River Watershed.....1964
..Upper Howard Creek Watershed.....1968
..Base Study for County.....1969
..Future Land Use Plan.....1969
..Christian County Water District.....1972
..Subdivision Regulations.....1968
..Soil Report.....1969
..Hopkinsville-Christian County Community Shelter Plan.....1969
..County Zoning Ordinance.....1970
..Comprehensive Water & Sewer Plan.....1973

Hopkinsville

..Hopkinsville Community Facilities Plan.....1960
..Hopkinsville General Plan.....1963
..Existing Land Use.....1964
..Economic Study.....1964
..Central Business District.....1965
..Neighborhood Analysis.....1965
..Land Use Plan.....1968
..Community Facilities Plan.....1968
..Capital Improvement Program.....1968
..Zoning.....1968
..Housing Study.....1969
..Lawns and Landscaping Soil Report - Hopkinsville and Adjacent Areas.....1969
..Fringe Area.....1970
..Commercial Area Study.....1971
..Little River Redevelopment Project.....1972
..Transportation Plan.....1973
..Community Management Plan.....1973
..Housing Strategy Study.....1973
..Community Change Project.....1973-1974

Pembroke

..Pembroke Subdivision Regulations.....1973
..Pembroke Zoning Ordinance.....1973

CRITTENDEN COUNTY

..Comprehensive County-Wide Water and Sewer Plan.1972
..Comprehensive County-Wide Plan and Housing Plan.....1973

LIVINGSTON COUNTY

..Base Map.....1968
..Existing Land Use Map.....1968
..Existing Land Use Analysis-Population and Economic Survey.....1968
..Land Use Plan.....1968
..Zoning Ordinance.....1968
..Comprehensive Water & Sewer Plan.....1971

Grand Rivers

..Base Map.....1968
..Existing Land Use Map.....1968
..Existing Land Use Analysis-Population and Economic Survey.....1968
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..Initial Housing Plan.....1973
..Base Map.....1974
..Existing Land Use Maps.....1974
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Eddyville

..Codes Program.....1965
..Base Map.....1969
..Existing Land Use Map.....1969
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..Comprehensive Plan.....1970
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Kuttawa

..Comprehensive Plan.....1960
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..Subdivision Regulations - Area Master Plan - Map.....1960
..Land Use.....1960
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TODD COUNTY

..Comprehensive Water and Sewer Plan.....1968
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Elkton

..Base Map.....1963
..Existing Land Use Map.....1963
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..Master Development Plan.....1963

Guthrie

..Base Map.....1965
..General Plan.....1965
..Existing Land Use Map.....1965
..Zoning Ordinance.....1965
..Subdivision Regulations.....1965
..Water Facilities - Engineering Report.....1970

TRIGG COUNTY

..Comprehensive Area Plan for Water & Sewer Systems.....1972

Cadiz

..Base Map.....1960
..Existing Land Use Map.....1960
..Existing Land Use Analysis.....1960
..Major Street Plan.....1961
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..Zoning Ordinance.....1963
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..Capital Improvements Budget.....1970
..Fringe Area Study.....1970
..Housing Element.....1970

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